REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1995	Final Report (07/94 - 07/95)

4. TITLE AND SUBTITLE
Central Materiel Services at Madigan Army Medical Center: A Case Study

5. FUNDING NUMBERS

6. AUTHOR(S)
Captain David A. Bitterman, Medical Service Corps, U.S. Army

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Madigan Army Medical Center
ATTN: MCHJ-DCA/CS
Tacoma, WA 98431-5000

8. PERFORMING ORGANIZATION REPORT NUMBER
7a-95

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army-Baylor University Graduate Program in Health Care Administration
U.S. Army Medical Department Center and School
Bldg. 2841, 3151 Scott Road
Fort Sam Houston, TX 78234-6135

19. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

A case study of the Central Materiel Services department at Madigan Army Medical Center was conducted in three phases to establish inventory levels of equipment located throughout the clinical areas of the hospital, to determine stockage levels of the most commonly used surgical instrument sets, and to conduct a pilot study showing the efficacy of an inventory management system using the Basic Laparotomy set as a study group. The clinical inventory identified a total of 779 separate lines of equipment, for a total of 4,581 instruments, sets, or other equipment. Eighty instrument sets were identified which represented 80% of the demand for sets within the hospital, and stockage levels to meet a 97% and a 99% demand satisfaction rate were computed and compared to actual inventory. Results from the pilot study showed significant differences between actual usage rates of instruments and stocked levels, but the sample size was too small to make recommendations for instrument stockage levels within the Basic Laparotomy set.

14. SUBJECT TERMS
inventory management, surgical instruments, Central Materiel Services

15. NUMBER OF PAGES
169

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
N/A	N/A	N/A	UL

CENTRAL MATERIEL SERVICES AT

MADIGAN ARMY MEDICAL CENTER: A CASE STUDY

A Graduate Management Project

Submitted to the Faculty of

the U.S. Army - Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

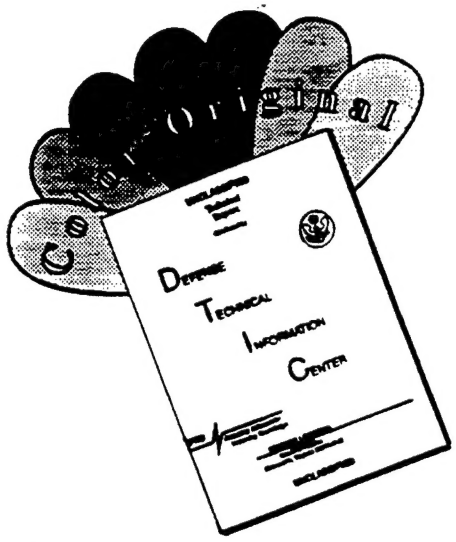
Master of Health Administration

by

Captain David A. Bitterman

May, 1995

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF COLOR PAGES WHICH DO NOT REPRODUCE LEGIBLY ON BLACK AND WHITE MICROFICHE.

ACKNOWLEDGMENTS

I would like to acknowledge the contributions of many people who made this project possible. Particularly helpful in all phases of this project were the personnel of Madigan Army Medical Center's Central Materiel Services, especially Sergeant First Class William Orton and Ms. Theda Parker. Their dedication to the never-ending mission of their department and my many requests made my dealings with them a pleasure.

I would also like to thank my colleagues who served as sounding boards during the many phases of this project. Through thick and thin, Captains Donald Hutson, Steven Smith, and John Gaal, USA; Lieutenants Dan Cornwell, and Cathi Culver, USN; and Major Bill Cross, USA, have been available to offer assistance and advice.

Finally, I must acknowledge the patience, understanding, and sacrifice of my wife, Kyong, and my children, Sean and Faith, while I completed this case study and the preparatory year leading to it. I am eternally grateful to them for helping me complete this program.

ABSTRACT

A case study of the Central Materiel Services department at Madigan Army Medical Center was conducted in three phases to establish inventory levels of equipment located throughout the clinical areas of the hospital, to determine stockage levels of the most commonly used surgical instrument sets, and to conduct a pilot study showing the efficacy of an inventory management system using the Basic Laparotomy set as a study group. The clinical inventory identified a total of 779 separate lines of equipment, for a total of 4,581 instruments, sets, or other equipment. Eighty instrument sets were identified which represented 80% of the demand for sets within the hospital, and stockage levels to meet a 97% and a 99% demand satisfaction rate were computed and compared to actual inventory. Results from the pilot study showed significant differences between actual usage rates of instruments and stocked levels, but the sample size was too small to make recommendations for instrument stockage levels within the Basic Laparotomy set.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

In a United States Army medical treatment facility, the department with the primary responsibility to decontaminate, sterilize, pack and store medical instruments is known as Central Materiel Services (CMS). In civilian hospitals, CMS is known as Sterile Processing Department (SPD), Central Services (CS), and other names, but its function is essentially equivalent to the military hospital's CMS department. Virtually millions of dollars of surgical instruments are processed and stored by these departments in large hospitals, for the types and variety of surgical instruments have become increasingly sophisticated in the past fifty years.

Madigan Army Medical Center is a 414-bed tertiary-care hospital with a major teaching mission located at Fort Lewis, Washington. Moved into in 1992, it is a modern facility with extensive networked information systems, interstitial space between floors to hide the mechanical systems, and self-guided robots that delivery supplies throughout the hospital (Figure 1). It has 14 operating rooms that are constantly in use; as a result, Madigan's CMS department is very busy, operating 24 hours a day. In addition to the operating rooms, the CMS department has over 50 other customers that it processes instruments for, to include most of the major clinics within the hospital, several Troop Medical Clinics, and many tactical medical units garrisoned at Fort Lewis. Central Materiel Service has many functions. First and foremost, it is the repository of surgical instruments that are used throughout the hospital. The personnel who work for CMS

perform basic maintenance on every instrument, and they arrange for more specialized maintenance for instruments that need it. The Central Materiel Service department also approves the purchase and orders all surgical instruments used by its customers. An important part of Central Materiel Services' duties is to package sterile instruments in sets for use in specific surgeries. Every surgeon at Madigan has a preference for the types and numbers of instruments that he or she uses for every surgical procedure he or she performs. Because of this, CMS must track and build custom instrument sets depending on the daily surgical schedule.

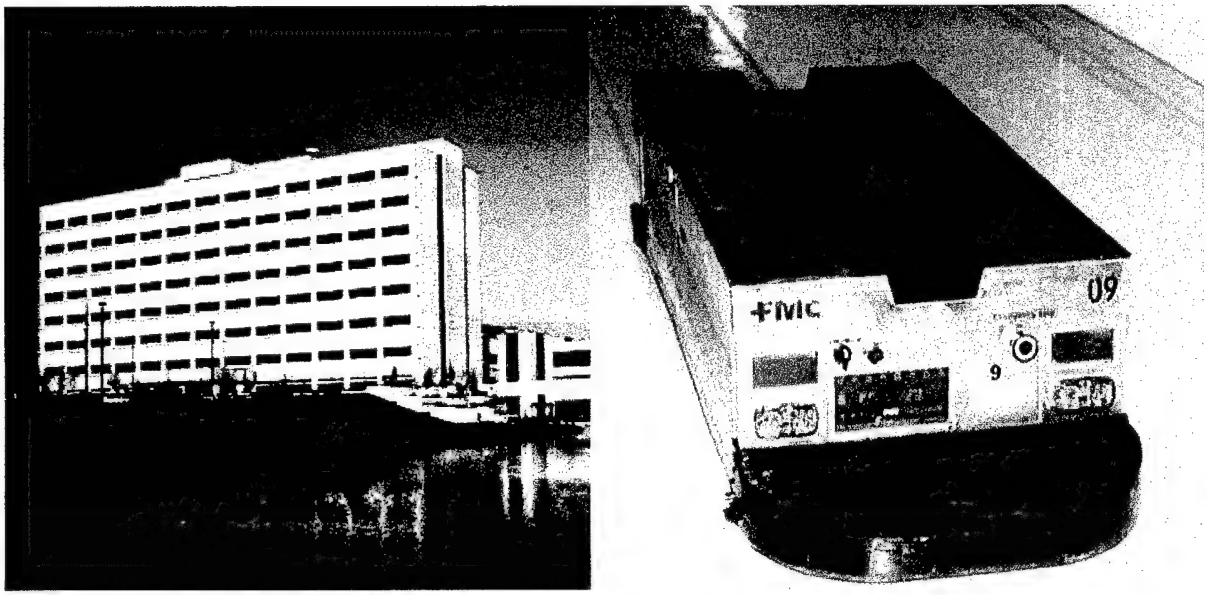


Figure 1. Madigan Army Medical Center and one of its robots

The process of building these sets is quite complex. Instruments leave the Operating Room and are transported down one floor to the Central Materiel Service department. They arrive in the "dirty" side of CMS, where they are sorted, opened, and placed in instrument trays for cleaning. They then travel by conveyor belt into a machine that cleans the instruments thoroughly. They arrive on the far side of the machine, travel down another conveyor, and finish in a holding bin. Instruments are taken from the holding bin to various workstations (Figure 2),

and trained Operating Room technicians build new instrument sets from inventory sheets generated by a computer. The instrument sets are then placed in either a steam or gas plasma sterilizer, and sterilized for a specific period of time.

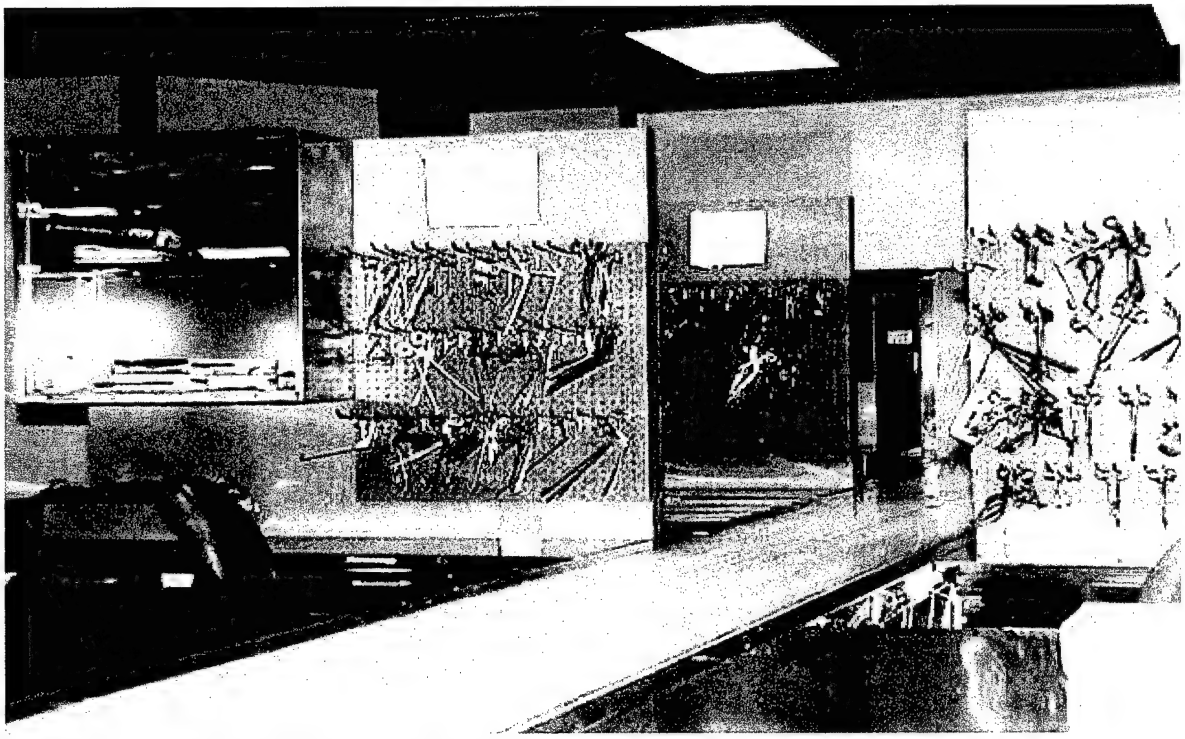


Figure 2. Assembly area for Instrument sets

Sterilized instrument sets are removed from the sterilizer and placed upon coded shelves for storage. Instrument sets, like pharmaceuticals, have expiration dates. So, each instrument set is marked with an expiration date as well as identification of the specific instrument set. During a typical one-week period in October 1994, CMS personnel processed 1,070 instrument sets or other surgical items.

The personnel of the CMS department also prepare case carts for surgeries scheduled for the next day. A case cart is a stainless steel cart on wheels that holds supplies and instruments

needed for one surgical case. Depending on the type of surgery, a case cart may have one or more instrument sets on it, along with the necessary sterilized and non-sterile linen, disposable supplies, and basins needed for the procedure. CMS personnel remove specific instrument sets from coded locations on the storage shelves, place them into the carts along with other supplies, and send the case carts to the operating room by an elevator system.

The size of an instrument set varies depending upon the type of surgery and surgeon performing the procedure. They can be as small as 15 instruments, or as large as 107 instruments. Because the instruments are specialized and machined of stainless steel or titanium, their value can be staggering. For example, a review of instruments ordered during fiscal year 1994 found the cheapest instrument to be an $8.00 probe, and the most expensive instrument an Aggressor forceps valued at $4,419. The average cost of instruments ordered during fiscal year 1994 was about $338, with total expenditure for instruments of over $228,000 dollars. Total supply expenditure for the CMS department during the same period was over 1.2 million dollars; this amount was more than 50% of the entire budget of the nursing department.

The CMS department has 329 different types of instrument sets, and the total number of sets is approximately 600. Twenty-eight personnel staff the department, including an officer and a noncommissioned officer in management positions, two supply personnel, a database manager, a receptionist/secretary, and twenty-two technicians. Both military and civilian personnel staff the department, and the department operates in three shifts every day of the week.

There is no standard CMS department, for each department must adapt to the special needs of its customers. For example, certain delicate instruments cannot be sterilized using steam sterilizers because the process damages the instruments. Instead, gas sterilizers or low

temperature sterilizers must be used. Because Madigan is a tertiary-care treatment center, it has many specialized instruments that must be processed with great care to extend their useful life.

Conditions which prompted the Study

In 1993, the Commanding General of Madigan Army Medical Center requested the Resource Management Division (RMD) conduct a study to determine why the Central Materiel Services department consistently exceeded its supply budget (Management Study, 1993).

Although the study consisted purely of interviews with the parties involved, the results were quite interesting. The study found that there were no inventory management programs in place in the CMS department, other than an automated database program which built custom packing lists of instruments for each surgeon. The situation at Madigan was not unusual for a hospital; the survey by RMD noted that of six civilian and military hospitals studied, only two had any inventory system. Good Samaritan Hospital and Fitzsimmons Army Medical Center inventoried each set before and after each use, and shortages were replaced by the operating room. The other hospitals conducted instrument counts before and after each surgery, but these counts were to ensure instruments were not left in the body cavities of patients, not for reasons of supply accountability. At the two other military hospitals surveyed, Tripler and Brooke Army Medical Centers, there was no accountability system in place. In fact, CMS personnel at Brooke consider instruments to be expendable, and they estimate an annual 10% loss of inventory (Management Study, 1993).

The study also found that the CMS department purchased all instruments for its customers without knowing how many other instruments of its type already existed within the hospital. Because some instruments are kept and sterilized in the clinics throughout the hospital,

CMS does not maintain control or visibility over these instruments. Therefore, individual clinics might order an expensive instrument for limited use when the identical instrument was idle in another clinic. There simply was no system to track the use of surgical instruments (Management Study, 1993).

The implications of this lack of control are significant. The CMS department was ordering specialized instruments for specific customers when the instruments already existed in another department in the hospital. Sometimes the instruments ordered by the clinics required expensive repair parts or additional items that would have to be ordered by CMS. No system was in place to track the location or maintenance status of individual instruments.

Instruments like scissors that needed periodic maintenance were not tracked by any system, which resulted in surgeons discovering they had a useless instrument while at the operating table. This condition often resulted in a telephone call from the operating room to the CMS department in an attempt to locate a duplicate instrument. The CMS department might then have to unpack a sterile instrument set to retrieve the duplicate instrument, necessitating repackaging and resterilization of that set.

Usage rates of instruments and the instrument sets were not monitored to establish stockage levels. CMS personnel built a certain number of instrument sets based on the experience of the senior technicians, but not on actual usage data. Finally, an unknown number of instruments were lost each year due to pilferage or being thrown into the laundry in the operating room.

One item the Resource Management Division did not address was the staff requirements of CMS. The RMD study noted that the CMS staff could not maintain accountability of its

supplies and equipment without appropriate resources, which included the staff necessary to conduct an inventory and a computer database that would track inventory, location, and usage data for each instrument set. The study could not comment on the availability of adequate staff to conduct the inventory, but it suggested the database would require at least an additional computer with the ability to read bar codes. These conditions prompted the Informatics Department at Madigan to investigate the potential for an automated system for management of surgical instruments. The Informatics Department contacted several equipment vendors and medical informatics companies to survey what technology was available to perform this task. They found several companies had developed the technology to bar code the stainless steel surgical instruments through a laser-etching technique. This bar code could be burned into each instrument at a cost of $1.00 - $1.50 per instrument (Breazile, 1994). Madigan's CMS department estimates that a total of 30,000 instruments will have to be bar coded for an effective system.

At this stage, Madigan's Informatics department has developed specifications for this Central Materiel Information System. Madigan has yet to issue a Request For Proposal (RFP) for contractors to develop an inventory management system, so the costs of the proposed system are undetermined. The Informatics and CMS departments have made tentative plans to change the system, but these plans have not been based on a formal study or analysis of the current problem.

It is important to note that the means to establish a manual inventory control system currently exists within CMS. A baseline inventory of instruments could be accomplished in two weeks, given a number of trained technicians who had no other duties. The department currently

inventories each set as it is built, and the same set of instruments is accounted for twice following surgery. The inventory sheet could be returned to CMS for accountability of lost or unused instruments, but currently CMS is not staffed for this very labor intensive process. The volume of instruments processed and the value of those instruments points out the need for an automated inventory management system within this department.

Statement of the Problem

There currently is no inventory management system in place within Madigan Army Medical Center to track the use, maintenance record, location, stockage levels, and accountability of surgical instruments. The lack of an adequate system has resulted in unnecessary purchases of equipment, inadequate maintenance of instruments, possible incorrect stockage levels of surgical instrument sets, and no accountability of very expensive durable surgical instruments.

Literature Review

Inventory management of surgical instruments has only recently been addressed by materiel managers. Yet, the value of surgical instrument inventories often exceeds the value of linen inventories by 300%, and can account for up to 50% of the total supply inventory. Becker reports that a mid-sized teaching hospital in a metropolitan area with an average of 6,000 surgical procedures per year has an estimated surgical instrument inventory of over $560,000 (Becker, 1990, 40). Madigan exceeds this surgical volume by 4,000 cases per year, and its estimated surgical inventory is over 2.2 million dollars. This inventory is an asset that must be rigorously controlled to reduce the operating costs of the hospital: too much inventory and an opportunity

cost is paid through unused instruments; too little inventory and "short costs" are paid through canceled surgeries or expensive disposable instrument sets (Annis, 1988, 80).

Various attempts to manage surgical inventories have been reported in the literature in recent years. Alta Bates Medical Center of Berkeley California achieved savings of $280,000 per year by moving to a just-in-time stockage system, and an additional $220,000 through reducing duplication in Operating Room inventories (Walera, 1993, 25). Starr suggests a similar approach to cutting Operating Room inventories: target the obsolete or duplicate instruments and supplies, and replacement costs are immediately reduced (Starr, 1993, 28). Fairview Riverside Medical Center, a 796-bed hospital from Minneapolis, recently cut its instrument budget by 60% by standardizing 464 instrument sets into 81 (Barlow, 1994). Simply standardizing suture varieties from 130 to 54 types saved one hospital $48,000 in annual costs (Robinson and Coates, 1991, 1212). Because Madigan's CMS has no inventory management system, it cannot identify duplicate or obsolete instruments easily, and standardizing its many custom instrument sets without automation would be nearly impossible with the available staff.

Other costs associated with inventory management must be considered also. Industry analysts put the cost of purchasing a product at an average of $35 to $85 (Congdon, 1992, 18). This includes time spent preparing, processing, and paying for the order. Some cost savings can be seen through the use of blanket purchase orders and single source purchasing (two techniques Madigan uses), but significant overhead costs still occur when ordering supplies. It can be argued that the cost of procuring instruments through the government's ponderous purchasing system is even greater than the industry average.

One hospital has cut costs for its laparotomy surgeries by contracting with a private company to provide high-quality surgical instruments and technicians. By doing this, the hospital has eliminated the need for many of the disposable instruments it was using before. In this type of arrangement, the hospital essentially "rents" the equipment when needed from the contractor. The contractor is still responsible for the cleaning and sterilizing of the equipment, and the hospital only pays for minor disposable needles for the procedure (Andersen and Bourne, 1994, 103).

Anderson reports that a product's true cost is also reflected in its quality, cost of use, and disposal costs. She notes that sometimes a hospital's culture will affect its worker's attitudes towards cost consciousness. At one facility with inattentive employees, management was astounded to find a pile of surgical instruments salvaged from the hospital's processed waste (Anderson, 1993, 20). Perhaps the employees would have been more conscientious about instrument use had they been paying for the instruments. Currently Madigan does not track instruments not returned with incomplete instrument sets, so customers may be careless about accountability.

Instrument maintenance is another important topic that must be addressed. Souhrada reports the efforts of Ottawa General hospital of Ontario, Canada to reduce instrument repair and replacement costs. Denis L'Abbe, the hospital's director of Supply, Processing and Distribution turned to other hospitals for benchmarks to follow for maintaining instruments, but he found that other hospitals had no idea what their specific costs were for maintaining instruments. So, he developed flowcharts of the different processes within his department to identify inefficiencies, and he also initiated an extensive repair and maintenance database. L'Abbe estimates an average

of 12 percent of an instrument's purchase cost will be used to maintain that instrument, and that figure is constantly adjusted in concert with actual maintenance costs (Souhrada, 1994, 60-64). Madigan has no system to track the maintenance of its surgical instruments; it simply uses the instrument until it cannot be used again without maintenance. Often this occurs in the operating room with a patient under anesthesia, putting the patient at risk until a replacement instrument can be found.

Another cost of CMS is realized through worker productivity. In a study done at Rowan Memorial Hospital in Salisbury, North Carolina, Virginia Coffey found that almost 50% of the CMS department's time was spent in sterilization activities, about 15% in decontamination activities, and 30% in "cart work," or filling individual case carts (Sabatino, 1992, 19). Logically, it follows that if the amount of time spent doing one activity can be reduced, then workers can devote the time to other activities. Currently, Madigan has no system to monitor productivity of its workers, so the CMS managers staff the different areas of the department based on experience and intuition. While this method may be adequate, no data exists to support current staffing policies.

In a survey of materiel managers conducted by Hospital Purchasing News, 68% reported that Operating Room inventories are managed manually; only one-third are managed using automated systems (Hall, 1994, 31). Yet, the successes of automated systems to manage surgical supplies are well documented in the literature. Rockingham Memorial Hospital in Harrisonburg, Virginia recently achieved a reduction in Operating Room inventory value of 65 percent within six months of instituting an integrated computerized inventory system (Newman and Bender, 1992, 11). Other approaches include using notebook computers and bar code "wands" to track

inventory (Hylton, 1987, 80), and using a computer to generate inventory charge labels which are affixed to a patient's chart (Weber and Sisson, 1984, 870).

Hard reports that automated Operating Room inventory control systems can help hospitals cut costs by standardizing and eliminating excess (Hard, 1990, 62). He notes in a later article that computerization of surgical instrument inventories was inevitable, for the growth in surgery and specialized instruments have increased the types and numbers of surgical instrument sets in recent years. However, as many as 30 percent of the instruments in these sets go unused (Hard, 1992a, 40). When an astute manager compares this fact with the annual replacement costs of surgical instruments ($114,000 a year for hospitals between 400 - 499 beds), the relative costs of computerizing a hospital do not seem as high (Hard, 41).

Automation of the CMS does not necessarily have to be an expensive proposition. Comerford reports automating the Sterile Processing department of Parkridge Medical Center in Chattanooga, Tennessee. He used a combination of computer-generated count sheets and manual systems for inventory management, and he used this count sheet to build instrument sets and maintain instrument accountability throughout the instrument's life cycle. His system cost less than $1,000 (Comerford, 1992, 41). However, hardware costs have decreased so significantly in the past few years that smaller hospitals are now automating. Hard reports that many smaller hospitals are automating purchasing, receiving, and inventory control and distribution because of the large volume of information exchange in these areas. He noted that the first step of one hospital when considering automation was to chart existing processes within the hospital (Hard, 1992b, 30).

Some hospitals are even installing computer terminals in the Operating Rooms to track the use of instrumentation. These systems can be used to adjust and reorder inventory, and they are also tied into the patient billing systems of the hospital (McClean, 1990, 518). Because Madigan cannot charge for the use of its instruments like many for-profit hospitals, this ability is not as important at this time. However, the ability to accurately track the use of instruments can lead to decreases in the numbers and types of instruments in sets.

Analysis of current inventory is addressed by two separate authors, Klee and Navarre. Both recommend the use of a technique called ABC analysis; an analysis where inventories are sorted to identify the 20% of line items that consume 80% of the supply activity within the institution (Klee, 1992, 24; Navarre, 1986, 34). Matwyshyn and Weinberg further note how ABC analysis can identify medical items incorrectly stocked and wasted (Matwyshyn and Weinberg, 1984, 60).

A dichotomy exists between the desires of OR managers to cut costs and the desires of surgeons to have any instrument they need available at all times, with little regard for cost. In an editorial that appeared in The American Journal of Surgery, Sussman and Gupta commented that administrators are often rewarded for "reaching and exceeding tactical (short-term) and strategic (long-term) goals that typically reflect operational efficiencies" and "physicians are rewarded through peer acceptance . . . and the success rate of procedures performed" (Sussman and Gupta, 1992, 1). In an academic medical center such as Madigan, it is very important to get the surgeons to buy into any cost-cutting measure.

Peter Drucker noted in the January/February 1995 issue of Harvard Business Review that information is management's most important tool (Drucker, 1995, 54). One author noted that

this statement is especially true of Operating Room managers, for information about productivity, core competencies, and resource allocation is needed to make smart decisions. As this author stated, "Information systems, when properly used, will make executives question assumptions, not just feed them the information they expect. Those who will be the most successful will figure out not only how to get their hands on lots of data but how to integrate it into strategy" ("The tool managers will truly need is information," 1995, 21).

Purpose

The purpose of this project was threefold; first, to identify surgical equipment that existed in the outlying clinics of Madigan Army Medical Center; second, to identify the instrument sets that accounted for 80% of the demand and to establish correct stockage levels for them; and finally, to develop an instrument set management model using one instrument set as a pilot study for future automation of the Central Materiel Service department. The purpose of the pilot study was to identify usage of instrument sets, usage of individual instruments within the set, and to establish good stockage levels for individual instruments within the set.

CHAPTER TWO

METHODS AND PROCEDURES

Phase 1: Clinic inventory. To identify surgical equipment that existed in the clinics throughout Madigan Army Medical Center, it was necessary to survey the clinics. I accomplished this by interviewing CMS and Logistics department personnel to determine which clinics were likely to have equipment. Likely candidates included all the clinics within the Department of Surgery, Family Practice, Obstetrics and Gynecology, Pediatrics, Orthopedics, and the Emergency Room. During the week of 19 - 23 December, eight trained Operating Room Specialists from Central Materiel Services inventoried surgical equipment in the clinics at Madigan. The decision was made to use trained personnel to ensure reliability of the inventory. The Central Materiel Service managers and I felt that using untrained personnel to inventory the equipment would prolong the inventory process and certainly lead to errors in identification of instruments and sets.

Participating clinics were notified by Central Materiel Service in advance of the inventory team arriving, and they were told the inventory was being done to establish a record of instruments for maintenance and accountability purposes. After the inventory, the inventory sheets were copied and returned to me for entry into a computerized database.

The database was created using Microsoft Access 2.0, and is archived in dBase format. Central Materiel Service uses dBase IV for other functions within CMS, so this format was chosen to ease analysis and use of the data. I encountered several problems during data entry

with usage of nomenclature and legibility of survey forms. For example, an instrument surveyor would note a clinic had 14 "Mosquitoes", but I was unfamiliar with that type of instrument. I frequently consulted with the individuals who conducted the survey to ensure the correct instrument name and type was entered into the database table. For example, I would note a descriptive entry on the survey form which read "curved Mosquitoes" as "Scissors, Mosquitoes, curved" in the database table. Items which were commonly known by a unique name, such as a "Minor Surgery Set" were noted by their given name in the database table.

All items listed on the inventory sheets were entered into the database. Although the purpose of the database is to capture data pertaining to surgical instruments and equipment, some surveyors inventoried disposable medical supplies or reusable linen. This data was included in the database when it was delivered to Central Materiel Service -- it was not purged. The managers of Central Materiel Service may decide at a later time to include these types of items on regular inventory surveys.

Phase 2: Analysis of Instrument Sets. This phase of my research consumed the majority of the research effort. Initially, I wanted to gather data about instrument set usage over a 30 day time period. Data to be collected included set type, date of usage, and how many sets used during a particular day. Further investigation within Central Materiel Service showed that personnel had been collecting this type of data for over a year to generate inventory sheets for building instrument sets. As each instrument set was used, CMS personnel would keep track of the type of set requested and sent to the Operating room. On a weekly basis, this data was consolidated and entered into a database. The database was then queried by CMS managers to

determine numbers of sets used by day in order to keep blank inventory sheets stocked within CMS. I chose to use the data which had been gathered to conduct my study, as it was very reliable and would result in a much more robust data set.

To conduct this study, a dBase IV report was written which listed all of the instruments and sets used during a nine month period, from January 1994 through September 1994. This report sorted all instruments and sets in order from the most used set to the least used set. In addition, daily usage of each set was detailed with monthly and total summary data, and the percentage of the total demand the line item accounted for. An extract of this report can be found in Appendix A. From this report, I selected the instruments and sets which accounted for 80% of the demand within Central Materiel Services. This subset of instruments and sets became my study group.

Next, I constructed a spreadsheet which detailed the daily use of each instrument or set in individual lines. To ensure accuracy of data entry, I cross-checked monthly and total summary data computed in the spreadsheet with the monthly and total summary data produced in the original dBase IV report. I then computed a mean and standard deviation for each line item within the spreadsheet in order to compute desired stockage levels.

Assuming a normal distribution for each set, it follows that for any given set the formula $\bar{x} + 2\sigma$ (the mean plus two standard deviations) would describe approximately 97% of the demand for a set, and $\bar{x} + 3\sigma$ would describe over 99% of the demand for a set (given a one-tailed distribution). For Central Materiel Service to meet the demand for a particular set at least 97% of the time, it needed to stock the number of sets equivalent to $\bar{x} + 2\sigma$. Similarly, to meet

demand 99% of the time CMS would need to stock $\bar{x} + 3\sigma$ number of sets. (Actual percentages are 97.7% and 99.9% respectively. Percentages were rounded down for purposes of clarity).

I next computed stockage levels each of the 80 sets identified as my study group, and X-bar run charts were constructed with these stockage levels noted on the chart. I made no attempt to choose a desired stockage level for individual sets, but I made each X-bar run chart available to the managers of Central Materiel Services to use in setting individual set stockage levels.

I was then able to compare my computed stockage levels with the current stocked level for each of the 80 instrument sets. The results of this comparison will be discussed later in this paper.

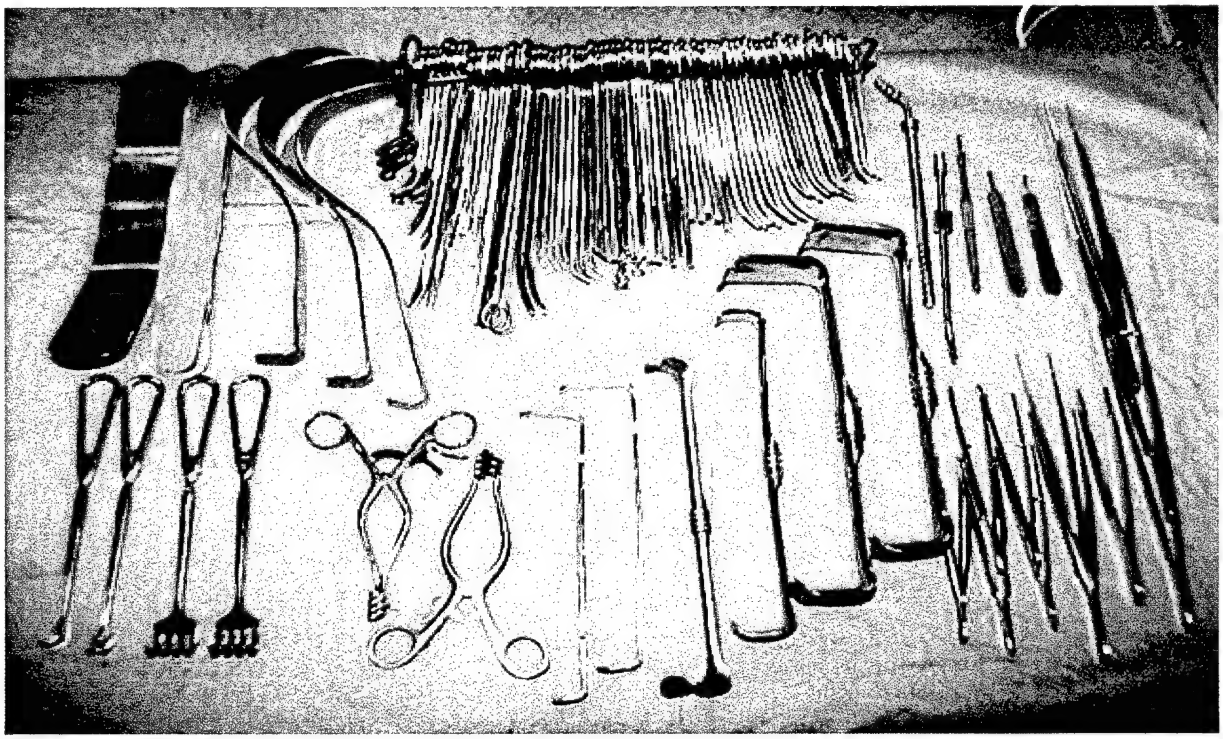


Figure 3. The Basic Laparotomy Set

Phase 3: Pilot study of Basic Laparotomy Set. Finally, I conducted a pilot study to demonstrate the efficacy of an inventory management system within Central Materiel Services. For this pilot study, I used the instrument set that I found to be used most often in Phase 2 of my study, the Basic Laparotomy set (Figure 3). This set is quite large (107 instruments) and is used by several services: Gastrointestinal, Genitourinary, General Surgery, and Vascular Surgery. For the study period, I collected two data items about each set as it was used for surgery: 1) instrument inventory as it left CMS and returned; and 2) numbers of individual instruments used.

Data collection was accomplished by modifying the standard inventory count sheet for the Basic Laparotomy set, adding a column for "Instruments Used" (Appendix B). All data items were entered into a spreadsheet program and analyzed. I expected to be able to answer the following questions with results from the pilot study:

- what was the usage rate of the Basic Laparotomy set?
- what was the usage rate of each service of the set?
- what was the normal loss rate of instruments?
- what was the loss rate of instruments for each service?
- what types and numbers of instruments are not used in the set?

Difficulties I experienced in collecting this information will be discussed later in this paper. This data can be used to quantify savings of an actual inventory management system using this model. For example, if a number of instruments can be eliminated from the set because they are rarely used, then those instruments can be used as replacements or removed from inventory. This particular problem was addressed several times in the literature review.

Reliability and validity. Problems with reliability and validity of the clinical instrument inventory were minimized through the use of trained Central Materiel Service personnel. Because these personnel were very familiar with the correct nomenclature of the instrumentation, errors in misidentification were minimized. To ensure content validity, I reviewed results of each service's survey with Central Materiel Service. Although the results of the inventory were quite impressive, there is a possibility that some instrumentation was unsurveyed. This possible error in measurement will be addressed in the near future if CMS institutes a regular periodic inventory schedule.

Validity of the second phase of the study was checked by cross-checking database reports of instrument set usage against the daily surgery schedule. Although some scheduled surgeries were canceled the day of surgery, the instrument sets were still "demanded" by the Operating Room and delivered as originally scheduled. Reliability of this part of the study was assured by limiting the number of supervisors within CMS who updated the database record of sets demanded during the time frame of the study.

Reliability of the pilot study was assured by giving each operating room technician using the laparotomy set a standard set of instructions regarding the inventory process. Each inventory sheet was prepared by Central Materiel Service personnel in a consistent manner to minimize extraneous variables within the study. I experienced some difficulty collecting data during this phase of the study; as a result, the reliability of some of the results is questionable. I will discuss this issue in detail later in this paper.

Time frame. Inventory of surgical instruments (Phase 1) occurred during the week of 19 - 23 December 1994, and the database was built over the next two months. Phase 2 started with data entry and analysis in early November 1994, and all work was completed by March 1995. Collection of data for Phase 3 began on 7 February with an initial placement of 100 inventory sheets with the Basic Laparotomy sets. Within three weeks, the first 100 sets had been used, and another set of 100 inventory sheets was entered into the inventory on 16 March. Data collection for this phase was completed on 18 April 1995.

Ethical Considerations. Because this study did not capture any patient information, confidentiality issues were not a concern. All survey instruments and inventory sheets were completed without capturing names of patients involved.

CHAPTER THREE

RESULTS

Phase 1. The first phase of this study identified clinical instrumentation that existed in the various services of Madigan Army Medical Center. The surveyors visited a total of 23 sites within the walls of Madigan and two sites that were isolated on another area of Fort Lewis. Surveyors identified a total of 779 separate lines of equipment, for a total of 4,581 instruments, sets, or other equipment (Appendix C). Central Materiel Services will use this database in the future as a baseline inventory for periodic inventories of clinical instrumentation.

Phase 2. The second phase of the study identified 80 instrument sets which accounted for 80 percent of the demand within Central Materiel Services. Appendix D summarizes the descriptive statistics for this phase of the study.

No instrument set was used every single day of the study period. In order to eliminate bias caused by including the days sets were not used (slack days, weekends, and holidays), means and standard deviations were calculated based on days each set was actually used. Although most surgeries at Madigan are performed during the weekday, some emergency surgeries are performed on weekends and holidays.

Once means and standard deviations were calculated, I calculated suggested stockage levels based on meeting demand for each set 97% of the time and 99% of the time based on the following formulas:

$$\text{Level to meet 97\% demand} = \overline{x} + 2\sigma$$

$$\text{Level to meet 99\% demand} = \overline{x} + 3\sigma$$

Once means and standard deviations were calculated, I constructed X-bar run charts for each of the 80 sets. On each chart I noted the 97% and 99% demand satisfaction levels (the level at which demand is satisfied either 97% or 99% of the time), and the average daily use. The X-bar run chart for the Basic Laparotomy set is shown in Figure 4, and all of the X-bar run charts are included at Appendix E.

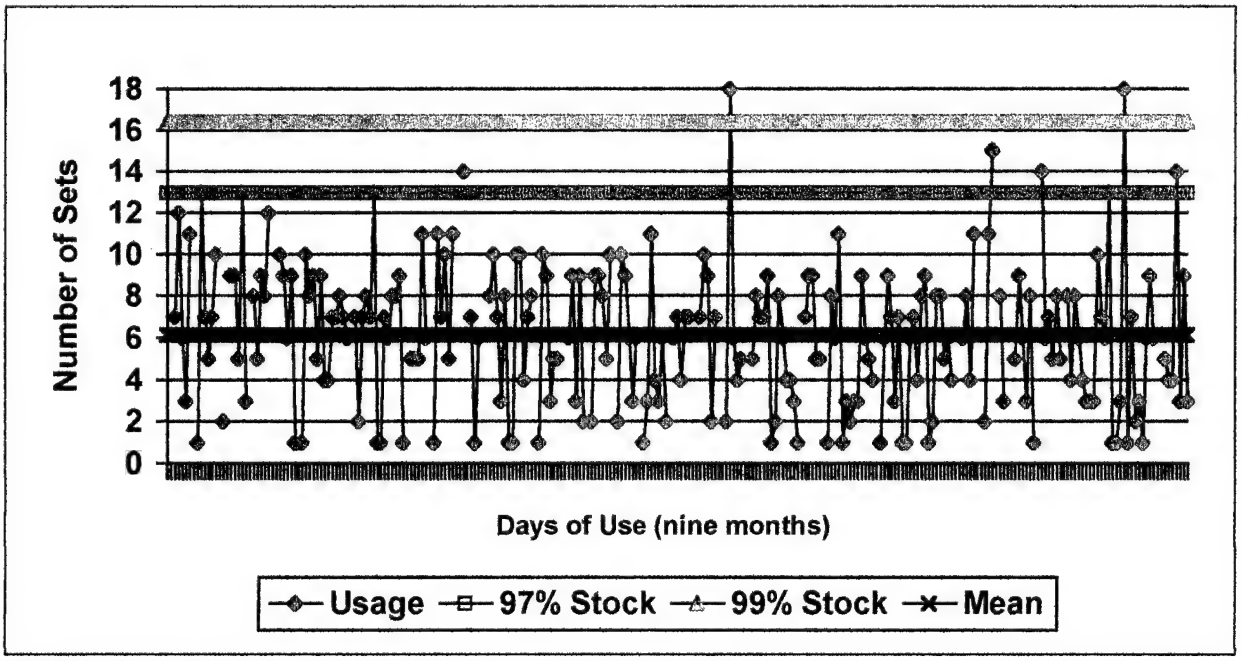


Figure 4. X-bar run chart for the Basic Laparotomy Set

The X-bar run chart for the Basic Laparotomy Set shows that with a mean of approximately 6 sets used/day, a good stockage level to meet demand 97% of the time is 13 sets. Likewise, a good stockage level to meet demand 99% of the time is approximately 16 sets. As expected in a normal distribution, a few days of use fall outside these recommended stockage levels. Methods to adjust for these outlier days will be discussed later in this paper.

I also compared the computed stockage rates with the current inventory levels stocked in Central Materiel Service. The computed stockage rates for the ten most used sets are shown in Table 1, with computed stockage rates for all 80 sets found in Appendix F.

As Table 1 notes, the current stockage rate greatly differs in many cases from either the 97% demand satisfaction rate, or the 99% demand satisfaction rate. In many cases, Central Materiel Services stocks too many sets for daily usage (Laryngeal Mirrors). In some cases, Central Materiel Service has a shortfall of equipment (Hand Set). I will discuss this issue at length in the next chapter.

Table 1. Computed Stockage levels for top ten sets demanded

Nomenclature	Computed		97% Stock Level	99% Stock Level	Current Stock Level	97% Excess or Shortage	99% Excess or Shortage
	Mean	Standard Deviation					
BASIC LAPAROTOMY SET	6.15	3.41	12.98	16.39	15	**2**	-1
OB INSTRUMENT/DOUBLE BASIN SET	4.21	2.86	9.93	12.79	12	**2**	-1
MINOR SURGERY SET	3.73	2.49	8.7	11.19	10	**1**	-1
BASIC ORTHO SET	2.95	1.92	6.79	8.71	8	**1**	-1
HAND SET	3.18	2.27	7.71	9.98	6	-2	-4
LARYNGEAL MIRRORS	3.07	1.67	6.41	8.08	10	**4**	**2**
LAMBOTTE OSTEOTOMES	2.32	1.35	5.03	6.38	4	-1	-2
C-SECTION SET	2.25	2.06	6.37	8.42	3	-3	-5
BOOKWALTER W/LARGE OVAL/ROUND RINGS	2.23	1.42	5.07	6.49	3	-2	-3
MINI DRIVER	2.29	1.36	5.02	6.38	4	-1	-2

Phase 3. The final phase of this study was an examination of individual instrument usage within the Basic Laparotomy Set. I experienced some difficulty collecting the data for this phase of the study. Of the initial 100 instrument count sheets I entered into the system for data collection, only 24 sheets were returned. Two of the sheets returned had to be thrown out, as the surgeries had been canceled and the set was not used. An additional 100 instrument count sheets were entered into the system, and very few were returned (eight total). In order to limit any errors due to the data being collected at two different times, I limited my data analysis to the first set of count sheets collected.

Statistical analysis of each instrument within the Basic Laparotomy Set was conducted using Statview 4.0® for the Macintosh, and the results are shown in Table 2. Using one sample *t*-tests with 21 degrees of freedom for all instruments, and an $\propto = .01$, the usage of instruments shown in blue type were found to be statistically different from the stocked level for each instrument.

Although most of the instruments were shown to be stocked at a level significantly different from the actual usage rate, I could not use the same methodology as in Phase 2 to compute stockage levels. I subjected each instrument data set to a normal distribution goodness of fit test in Microstat®; every instrument data set was found to be significantly different from a normal distribution ($X^2_{(5\ df)}$ at a 95% confidence interval).

Because the response rate for this phase of the study was so limited, I cannot recommend stockage levels be set for these instruments from this study. In almost every case, the formula I used in Phase 2 of this study ($\overline{x} + 2\sigma$) returns a value that meets or exceeds the current stockage level. In the case of ten instruments (Volkmans, sharp; Criles; Kellys; Rankins; Allis; Kochers;

Judd-Allis; Babcocks 8"; Right Angles 7", delicate; and Lahey-Mixters) the formula does return a value lower than the current stockage level, but the sample size is too small to recommend with any confidence a good stockage level.

Table 2. Statistically significant results for Phase 3

Instrument type	Stocked level	Mean	Standard Deviation	Coefficient of Variation	*t*-value	*P* value
Ribbons 2" /1.5" /1"	3	.591	.796	1.348	14.189	<.0001
Deaver 2" /1.5" /1"	3	.545	1.011	1.853	11.390	<.0001
Richardson Large	2	1.091	.750	.688	5.684	<.0001
Richardson Small	2	1.091	.971	.890	4.389	.0003
Army-Navys	2	.182	.588	3.237	14.491	<.0001
Veins	2	.318	.716	2.251	11.014	<.0001
Volkmans Sharp	2	.136	.468	3.429	18.695	<.0001
Weitlaners Dull	2	.227	.612	2.692	13.588	<.0001
Tissues 5.5"	2	.500	.859	1.718	8.189	<.0001
Adsons	2	1.636	.790	.482	2.160	.0425
Russians 6"	2	.318	.716	2.251	11.014	<.0001
DeBakeys 8"	2	1.545	.858	.555	2.485	.0215
DeBakeys 10"	2	1.182	1.006	.852	3.813	.001
Tissue 10"	1	.136	.351	2.576	11.533	<.0001
Dressing 10"	1	.045	.213	4.690	21.000	<.0001
Bonney (Silver Handle)	1	.727	.550	.757	2.324	.0303
Knife Handles # 3	2	1.409	.734	.521	3.775	.0011
Knife Handle # 7	1	.318	.477	1.498	6.708	<.0001
Adson Suction	1	.182	.395	2.171	9.721	<.0001
Poole Suction	1	.500	.512	1.024	11.583	<.0001
Mosquitoes Curved	6	3.227	2.349	.728	5.537	<.0001
Mosquitoes Straight	2	.455	.858	1.887	8.45	<.0001
Criles	8	2.500	2.874	1.150	8.975	<.0001
Kellys	8	4.909	2.653	.540	5.464	<.0001
Rankins	2	.182	.588	3.237	14.491	<.0001
Allis	4	1.318	1.555	1.180	8.090	<.0001
Kochers	4	1.364	1.529	1.121	8.088	<.0001
Judd-Allis	2	.500	.859	1.718	8.189	<.0001
Babcocks 8"	4	.545	1.143	2.096	14.171	<.0001
Right Angles 7" Delicate	2	.500	.802	1.604	8.775	<.0001
Lahey-Mixters	4	.682	1.249	1.832	12.458	<.0001
Tonsils	4	1.409	1.501	1.065	8.096	<.0001
Rochester Peons	2	.591	.908	1.537	7.278	<.0001
Sponge Forceps	3	1.091	1.151	1.055	7.780	<.0001
DeBakey Needle Holder 9"	1	.500	.512	1.024	4.583	.0002
Hegar Needle Holders 7"	2	1.591	.734	.461	2.614	.0162
Hegar Needle Holders 6"	2	.591	.908	1.537	7.278	<.0001
Towel Clips Large	4	2.727	1.907	.699	3.130	<.0051
Linen Clips Large	2	1.091	.921	.844	4.629	.0001
Mayo 7" Curved	1	.682	.477	.699	3.130	.0051
Mayo 7" Straight	1	.864	.351	.407	1.821	.0829
Metz 7"	1	.727	.456	.627	2.806	.0106
Nelson 9" Curved	1	.682	.477	.699	3.130	.0051
Nelson 9" Straight	1	.455	.510	1.121	5.020	<.0001

Another indicator of how clustered around the mean the samples are is the coefficient of variation. This measure is a ratio of the standard deviation to the mean for each instrument. In most cases the coefficient of variation for the individual instruments is a number greater than one -- in some cases this measure exceeds three or four. Clearly the distribution of samples around the mean for these small sample sizes precludes predictive modeling.

CHAPTER FOUR

DISCUSSION

The investment in surgical instruments in a large teaching hospital is quite significant. In terms of dollar amounts and volumes processed, any reduction in numbers of instruments stocked can quickly result in substantial savings to the system. The scope of the problem within a Central Materiel Services department is so large that often the easiest approach is to avoid trying to control the instrument inventory, or to place only limited restrictions on types and numbers of instruments ordered. If ungoverned, the system quickly results in excess inventory, budgets being overrun, and overworked employees as they attempt to cope with the inventory.

Madigan is no exception. Recent drawdowns in military and civilian personnel strength and shrinking budgets have made the issue of controlling instrument inventory an important one. Madigan must find some way to reduce expenditures for surgical instrumentation.

This issue is not as important in a non-military, for-profit hospital. In a for-profit hospital, the cost of the inventory and processing is shifted to patients and third party payers. Although it is important to control costs, the cost of the hospital's inventory is lessened by the considerable profits earned in surgery. Madigan realizes little revenue for its surgical cases; it only receives a limited amount of money from third party payers of patients who have medical insurance outside the Department of Defense system. The vast majority of Madigan's budget comes from a capitated payment based on the number of people served.

It is not cost effective to track every single instrument that exists within the walls of Madigan. Literally thousands of instruments are processed by the Central Materiel Service department each day. It is much more effective to focus on high-volume and high-cost instrument sets and instruments to minimize variation in the system.

Phase 1. This phase of my study focused on increasing the visibility of high-cost instrumentation. Although I did not pursue placing a dollar amount on the instruments that were inventoried for this study, the Central Materiel Service department can use the database I developed to monitor future expenditures. Although this phase of the study was not strict theoretical or applied research, it resulted in real benefit for this hospital, for it identified where the high-cost instrumentation exists within Madigan.

In order for this phase of the study to continue to have value, Central Materiel Service must continue to use the database. They must conduct periodic surveys of the instrumentation and seek accountability of missing instruments. Clinics belonging to Madigan must be held liable for missing instrumentation -- either the clinics need to buy replacement instrumentation or their budgets should be decremented by the value of missing inventory.

Another use for this inventory is in setting up a maintenance schedule. All scissors must be sharpened periodically; many clamps must be straightened so they will "lock" normally. Now, Central Materiel Service has a database it can use to rotate instrumentation through scheduled maintenance. Central Materiel Service can query its database to determine numbers of scissors in ambulatory clinics, and it can notify 10% of the clinics each month to produce their sharps for maintenance.

Central Materiel Service can also use the database as a check of inventory prior to ordering new instrumentation. For example, if the Department of Family Practice orders an endoscope, Central Materiel Service can check its database to see where endoscopes currently exist within the system. The Gastrointestinal service might have an endoscope with excess capacity; it would certainly be cheaper for Madigan to utilize all of the capacity of the little-used endoscope instead of ordering a new one. If Central Materiel Service did find a need to order an endoscope, they might be able to order one of the same make/model as others listed in the database, standardizing the maintenance and repair parts throughout the hospital.

Because the database is archived in a non-proprietary industry-standard format, Central Materiel Service will be able to migrate it to an automated system if one is purchased. Although this may seem to be a trivial matter, the terrible experience the Department of Defense has had in retrieving data elements from some of its legacy information systems like the Composite Health Care System (CHCS) makes an open architecture database design very important.

Phase 2. As stated earlier in this paper, this phase of the study consumed the majority of my research time. I chose to limit the study to the instrument sets that accounted for 80% of the demand for sets because I had to focus my efforts. I manually inputted daily usage rates for all 80 selected sets from the original dBase IV report I received from Central Materiel Services. The data entry for this phase took at least 150 hours, with another 30 hours of data analysis. If I had not limited the study I would not have been able to complete this project in a timely manner.

Another factor made it necessary to limit this phase of the study to the top 80% of sets demanded. Many of the instrument sets were only requested occasionally during the nine-month

study period; in fact, 173 different types of sets (of the 329 total) were requested 20 times or less. Had I examined all of the instrument sets, I would have encountered the same difficulty I encountered in phase 3 of this study: there would simply not have been enough samples to build a predictive model for stocking the sets.

The X-bar run charts are a powerful graphic tool that the Central Materiel Service managers can use to adjust their inventory. They can see at a glance a nine-month daily history of their top "frequent flyer" instrument sets, and make informed decisions about stockage levels. Certainly the individual X-bar run charts are an easier tool to use than the table shown in Appendix F with the same information.

The users of the instruments must decide at which level to stock each instrument set. It is clear from the data that the computed stockage rates vary greatly from the actual stockage rates in some cases, but it would be presumptuous of me to recommend any given stockage level based on my research. I can, however, recommend that this information be used as a guide in setting the inventory levels. Other factors the managers might consider include:

- is the instrument set for an elective surgery procedure, or is it non-elective?

- are extra sets of a given instrument set needed for a hospital expansion mission during mobilization?

- if a lower stockage level for an instrument set is selected, can surgeries be rescheduled for another day?

The answers to these questions may present extraneous factors that influence at which level the managers choose to stock the sets. As an example let's consider the Basic Plastic Set, used in elective plastic surgeries. It might make sense to stock this set at the lower stockage rate

of 97% demand satisfaction because elective surgeries tend to have a lower priority than other types of surgery. Using the same logic, the Central Materiel Service managers might choose to stock the C-section set at a 99% demand satisfaction rate in order to have this set always on hand.

A side benefit of this study came early in the year when I presented my initial findings to the Noncommissioned Officer-in-Charge (NCOIC) of Central Materiel Service. A close examination of the data showed that on a few days, more sets were used than were actually in the stocked inventory. This is not an error in measurement, but it reflected instrument sets that had been flash-sterilized in order to meet the high demand on a given day.

Flash sterilization is the process where cleaned instruments are placed in small sterilizers (located in the operating room area) and heated to high temperatures until sterility is established. The problem with "flashing" instruments is that the process is slow and somewhat dangerous; operating room personnel must wait until instruments cool down enough to touch prior to use. In addition, the sterilizers used in the operating room area are much smaller than the mass-production models found in Central Materiel Service, so many fewer instruments are processed at any one time. Flash sterilization is a safe and effective way of sterilizing surgical instruments, but according to the NCOIC should be done as an exception and not on a regular basis. It is much safer and more efficient to use a prepacked and mass-produced instrument set prepared by Central Materiel Service.

Another problem with flashing instruments is that it can delay surgeries. During a discussion with the Hospital Administrator of Group Health Cooperative of Puget Sound, he noted that his hospital's operating rooms cost $15 dollars a minutes to operate (Armstrong,

1995). If you add to this the opportunity cost of delaying an Anesthesiologist or a team of Surgeons, you can see that delaying a surgery while waiting for a set of instruments to cool can rapidly add up.

The ideal situation would be to set a stockage level based on the data I am presenting, and then schedule surgeries around the available inventory. Many sets are used by numerous surgical services, and these services compete for the use of operating room suites and instrument sets. Creating a manual system which matched the needs of the surgeons with the available rooms and sets would be next to impossible without an automated tool to manage these resources.

In fact, operating rooms are already scheduled at Madigan by an automated system. The Department of Anesthesia has developed a database called the Surgical Information System which matches operating rooms, Surgeons, and Anesthesiologists. Central Materiel Service uses this system every evening to build surgical case carts for the next day. A paper printout of the next day's surgery schedule is produced from the database by Central Materiel Service. The case carts are built for each surgical case based upon the name of the surgeon and the type of surgery he will perform. Central Materiel Service currently meets the ever-changing daily demand by having overstocked inventory on its shelves or by flash sterilizing when an instrument set is not immediately available. If the Surgical Information System could automatically query the available stock of instrument sets, surgeries would not be scheduled without the necessary instruments.

As detailed in the last chapter and in Appendix F, there are significant differences in many cases between the current stockage level of sets and the computed levels. The sets

identified as excess represent an opportunity cost lost because the inventory is sitting on the shelf. This inventory should be broken down and warehoused as replacement instruments, sold to a third party, or returned for credit (if available) to the specific instrument manufacturers. By doing this, Central Materiel Service can recover some of the lost opportunity cost already sunk into the initial purchase of instruments.

Shortages of instrument sets represent a different story. Having too little inventory may become a quality of care issue. If surgeries are postponed or canceled because of the unavailability of instrument sets, necessary surgeries are delayed and the institution may be pecuniary liable for allowing an unsafe condition to occur. Because of the inefficiencies and dangers of flash sterilization, it should not be relied upon as a method to deal with shortages of instrument sets.

Phase 3. The results of this pilot study show that there are significant differences between the usage rate of individual instruments within the Basic Laparotomy set and the actual stockage level, but the sample size of instrument count sheets returned was too small to create a predictive model. Why were so few count sheets returned?

The directions for how to complete the study and the purpose of the study were clear and easy to understand. The count sheets and the study were introduced and discussed at several meetings attended by the operating room personnel before and during the course of the study. At all times, the importance of the study and the study procedures were explained. When the circulating nurse and the operating room technician received the count sheet inside the operating room, they could see directions printed clearly on the top of the count sheet (Appendix B) which

detailed the study procedure and the collection point for the count sheets. Yet, I received only a limited response to the study.

I believe the operating room personnel had no incentive to complete the instrument count sheets. The circulating nurse and operating room technicians who do the instrument counts did not see the value in completing the study, so they opted not to participate on a large scale. If this study is repeated in the future, I suggest that an incentive system be part of the study. Perhaps the circulating nurse could print and sign her name on the count sheet prior to turning it in, and the nurse with the most count sheets returned would get a three-day pass. Whatever the incentive, the study must have some intrinsic value to the people participating in it or it will not be a success.

I expected to be able to answer several questions from the results of this study based on data I would collect from the instrument count sheet:

- what was the usage rate of the Basic Laparotomy set?
- what was the usage rate of each service of the set?
- what was the normal loss rate of instruments?
- what was the loss rate of instruments for each service?
- what types and numbers of instruments are not used in the set?

As it turned out, the instrument count sheets that were returned contained many blanks in the areas which would have contained the data answering some of these questions. For example, in almost every case the blank on the instrument count sheet that identified the using service was left empty. In no case was any instrument identified as being "lost" by the using surgical team. The only data field that was consistently filled out on the instrument count sheets that were

returned was the numbers of instruments actually used in the procedure. Therefore, the only question I could logically answer from the results of this study is the last question: what types and numbers of instruments are not used in the set?

Another factor might affect the usage rates of these instruments. The Basic Laparotomy set is seldom used by itself; it more commonly is used with at least one other instrument set. The instruments from the other instrument sets in use are available to the surgeons at the same time as the instruments from the study, so the usage rates of instruments in the study can be affected if another similar instrument is available from another set. Complicating this factor is the knowledge that the Basic Laparotomy set is used by at least four different surgical services for a variety of surgical procedures, so the extraneous instrument sets are not the same for every procedure.

I will discuss recommended changes to this phase of the study in the following chapter.

CHAPTER FIVE

RECOMMENDATIONS AND CONCLUSION

As I have outlined in this paper, Madigan can take several steps to start controlling its surgical instrument inventory. The efforts I have made to date are simply a start; to truly control the inventory requires a multidisciplinary team effort from surgeons, nurses, and Central Materiel Services personnel. All team members must want to affect change in the current system, for change in the system will result in controlled costs and improved quality through a reduction in variation.

I have several recommendations. First of all, the Central Materiel Service department should institute periodic surveys of all ambulatory clinics within Madigan, using the database developed during Phase 1 of this study. All disposable supplies should be purged from the database, and the Central Materiel Service department should concentrate their efforts on identifying all high-cost instrumentation. There are several techniques to do this; the most common technique used in U.S. Army logistics is to survey 10% of the line items each month, thus ensuring that all equipment gets inventoried at least once per year.

Central Materiel Service should begin tracking newly ordered instrumentation as it becomes part of the ambulatory clinic inventory. New instrumentation should be inputted into the database prior to it being delivered to the clinics to ensure visibility. If instrument bar coding ever comes to Madigan, this would also be an opportune time to input bar codes into the database prior to delivery.

In the same way, Central Materiel Service should check the database prior to ordering high-cost instrumentation to see if excess capacity exists in other places in the hospital. It might be cheaper to consolidate certain ambulatory surgical procedures in a given location within the hospital rather than trying to replicate numerous surgical sites at different clinic locations.

All instrumentation needs to be ordered through Central Materiel Service with the approval of a multidisciplinary utilization committee. If the committee disapproves the purchase of an instrument or set, then individual clinics should not have the latitude to order the instrumentation independently. This approach would assist Central Materiel Service in maintaining visibility over clinical instrumentation, and it would help in standardization of repair parts.

Central Materiel Service should review stockage levels semiannually using a rolling 12 months worth of data to ensure a good data set. A semiannual review would ensure that the department captures changes in the usage rates of instrument sets. If Central Materiel Service staff review levels more often, they might find that seasonal fluctuations due to military rotation schedules and other reasons affect usage rates too much to quickly add or subtract new sets.

I also recommend that the software model I used in this study be refined to allow Central Materiel Service staff to easily retrieve the data. If you recall, I inputted data from a database into a spreadsheet, and then constructed X-bar run charts using presentation graphics software. This approach worked well, but it was very time consuming to manually manipulate the data. An alternative would be to construct the same software model using a suite of applications (like Microsoft® Office Professional or Lotus® Smartsuite) linking the applications to each other so the usage rate reports could be automatically generated. This would require a certain level of

programming time by someone skilled in Microsoft® Windows and database programming, but it is certainly possible. This approach would require a purchase of software and some consulting expenditures to set the system up, but it could then be used on demand by Central Materiel Service staff.

I believe Central Materiel Service staff should meet with a multidisciplinary team of surgeons and nursing staff to review the X-bar run charts I generated. They should develop some simple guidelines for use in the future by Central Materiel Service that institutes at what level each set should be stocked. For example, the team might decide that all elective surgery sets would be stocked at a 97% demand satisfaction level, and all non-elective sets would be stocked at the 99% level. By developing these guidelines, Central Materiel Service would be able to routinely change stockage levels in the future as needed.

Once all stockage levels are set, Central Materiel Service should remove excess inventory from the shelves and attempt to liquidate or warehouse it. Because of the peculiarities of the military system, it is doubtful that Central Materiel Service would be able to sell the instrumentation at a reasonable rate -- most likely the only option to recoup any expenditure would be to turn the instrumentation over to the Defense Marketing Reutilization Office at a fraction of the worth of the instruments. A better approach might be to stockpile the instrumentation in like types until needed for replacement.

Stockage levels should be incorporated into the Surgical Information System database. This would ensure that no surgeries are scheduled for a procedure when all instrument sets are in use. As stockage levels of instrument sets reach a level that is more reflective of actual usage rates within the hospital, conflicts over the use of a limited number of sets will begin to occur

with more frequency. When this occurs, the Surgical Information System should have the ability to reschedule surgeries within a 24-hour period.

Phase 2 of this study also identified some shortages in equipment sets. Central Materiel Service should order the instrumentation necessary to complete new sets, or it should use instrumentation cannibalized from excess sets to complete the new sets. This would minimize the flash sterilization of instrument sets in the operating rooms, and reduce the delay in surgeries while waiting for flashed instruments to cool.

Phase 3 of this study should be repeated, but it should have an incentive system attached to the data collection portion of the study. An incentive to return properly completed sheets would be easy to design; each circulating nurse completing the sheet could legibly sign his or her count sheet prior to returning it, and the nurse with the most sheets returned would earn a day off with pay. This expenditure in salary would be more than adequately returned through a reduction in instrumentation in any given set.

Once good statistical results were returned with recommended stockage levels for individual instruments, a multidisciplinary team of surgeons, nurses, and Central Materiel Service staff should review the recommended stockage rates for adequacy of instrumentation. Newly constructed test sets using the recommended stockage rates should be inserted into the normal surgery schedule. Supplementary sets made up of the instrumentation eliminated from the set should be held in reserve, but these sets should not be opened unless needed. All instances of supplementary sets being used should be documented and reviewed, and the test sets should become institutionalized after a set time or number of uses.

Central Materiel Service staff should concentrate their efforts on the highest-volume, highest-cost sets initially, and then they should continue until all of the sets accounting for 80% of the demand have been studied. Central Materiel Service staff might also consider whether building, sterilizing, and stockpiling sets that are only used occasionally is cost effective -- a better approach might be to establish a central pool of instruments to draw from and to build custom "just-in-time" sets as they are needed.

In chapter one of this paper, I wrote of the possibility of bar coding instrumentation as a means of establishing some control over the instrumentation. Bar coding in itself is not a solution; bar coding must be used in conjunction with clear and logical inventory management models before Madigan regains control over its surgical instrumentation. I do not know whether bar coding would even be a cost effective tool to use within Madigan -- I believe that the staff of Central Materiel Service should consider solving the larger problem of controlling its instrument sets and controlling the new purchasing of instruments first. Once those problems are solved, control over individual instruments might be worthwhile.

In conclusion, I would like to summarize my findings. By inventorying clinical surgical instrumentation and creating an easily usable database, the Central Materiel Service department now has the ability to track accountability and maintenance of instrumentation that exists in the hospital outside their span of control. Through a review of the usage of instrument sets over a nine-month period in 1994, I was able to identify the sets that accounted for 80% of the demand and establish recommended stockage levels for each set. Finally, through a pilot study of the Basic Laparotomy set, I was able to identify statistically significant differences between actual

instrument usage rates and their current stock levels, but I was unable to recommend stockage rates for individual instruments. Through the course of the study I identified problem areas within the Central Materiel Service department and Madigan Army Medical Center, and I provided solutions to those problems where I could.

Currently Madigan's Central Materiel Service department is full of extremely hard-working professional staff members who diligently work at processing instrument sets. The staff and management of the department have come under criticism during the past few years for expenditures beyond their allowed budget, but in many cases the spending has been caused by factors outside the control of the department. Management of the department has had to deal with civilian and military drawdowns, shrinking budgets, and organizational change throughout the hospital while supporting the hectic pace of the operating rooms two floors above. The management of the department has simply had no time to conduct the kind of research outlined in this paper. The entire staff of this department should be commended for their hard-work and dedication to patient care.

APPENDIX A

EXTRACT OF dBASE IV INSTRUMENT SUMMARY REPORT

BEGINNING DATE: 01/01/94
ENDING DATE: 09/31/94

SET LEV	SET NAME	DATE USED	DAY USE	MON USE	TIME TOTAL	% OF SETS	CUMUL % SET
15	BASIC LAPAROTOMY SET	01/03/94	7				
		01/04/94	12				
		01/05/94	6				
		01/06/94	3				
		01/07/94	11				
		01/09/94	1				
		01/10/94	13				
		01/11/94	7				
		01/12/94	5				
		01/13/94	7				
		01/14/94	10				
		01/16/94	2				
		01/18/94	9				
		01/19/94	9				
		01/20/94	5				
		01/21/94	13				
		01/22/94	3				
		01/24/94	8				
		01/25/94	5				
		01/26/94	9				
		01/27/94	8				
		01/28/94	12				
		01/31/94	10		175		
		02/01/94	9				
		02/02/94	6				
		02/03/94	9				
		02/04/94	1				
		02/06/94	1				
		02/07/94	10				
		02/08/94	8				
		02/09/94	9				
		02/10/94	5				
		02/11/94	9				
		02/12/94	4				
		02/13/94	4				
		02/14/94	7				
		02/15/94	7				
		02/16/94	8				
		02/17/94	7				
		02/18/94	6				
		02/20/94	7				
		02/21/94	2				
		02/22/94	7				
		02/23/94	8				
		02/24/94	7				
		02/25/94	13				
		02/26/94	1				
		02/27/94	1				
		02/28/94	7		163		
		03/01/94	6				
		03/02/94	8				
		03/03/94	8				

BEGINNING DATE: 01/01/94
ENDING DATE: 09/31/94

SET LEV	SET NAME	DATE USED	DAY USE	MON USE	TIME TOTAL	% OF SETS	CUMULA % SETS
15	BASIC LAPAROTOMY SET	03/04/94	9				
		03/05/94	1				
		03/07/94	5				
		03/08/94	5				
		03/09/94	5				
		03/10/94	11				
		03/11/94	6				
		03/13/94	1				
		03/14/94	11				
		03/15/94	7				
		03/16/94	10				
		03/17/94	5				
		03/18/94	11				
		03/21/94	14				
		03/23/94	7				
		03/24/94	1				
		03/25/94	6				
		03/28/94	8				
		03/29/94	10				
		03/30/94	7				
		03/31/94	3	165			
		04/01/94	8				
		04/02/94	1				
		04/03/94	1				
		04/04/94	10				
		04/05/94	10				
		04/06/94	4				
		04/07/94	7				
		04/08/94	8				
		04/10/94	1				
		04/11/94	10				
		04/12/94	9				
		04/13/94	3				
		04/14/94	5				
		04/15/94	5				
		04/18/94	6				
		04/19/94	9				
		04/20/94	3				
		04/21/94	9				
		04/22/94	2				
		04/24/94	2				
		04/25/94	9				
		04/26/94	9				
		04/27/94	8				
		04/28/94	5				
		04/29/94	10	154			
		05/01/94	2				
		05/02/94	10				
		05/03/94	9				
		05/04/94	6				
		05/05/94	3				
		05/06/94	6				

BEGINNING DATE: 01/01/94
ENDING DATE: 09/31/94

SET LEV	SET NAME	DATE USED	DAY USE	MON USE	TIME TOTAL	% OF SETS	CUMUL % SETS
15	BASIC LAPAROTOMY SET	05/08/94	1				
		05/09/94	3				
		05/10/94	11				
		05/11/94	4				
		05/12/94	3				
		05/13/94	6				
		05/14/94	2				
		05/16/94	6				
		05/17/94	7				
		05/18/94	4				
		05/19/94	7				
		05/20/94	7				
		05/23/94	7				
		05/24/94	10				
		05/25/94	9				
		05/26/94	2				
		05/27/94	7				
		05/30/94	2				
		05/31/94	18	152			
		06/01/94	6				
		06/02/94	4				
		06/03/94	5				
		06/06/94	5				
		06/07/94	8				
		06/08/94	7				
		06/09/94	7				
		06/10/94	9				
		06/11/94	1				
		06/12/94	2				
		06/13/94	8				
		06/14/94	6				
		06/15/94	4				
		06/16/94	4				
		06/17/94	3				
		06/18/94	1				
		06/20/94	7				
		06/21/94	9				
		06/22/94	9				
		06/23/94	5				
		06/24/94	5				
		06/26/94	1				
		06/27/94	8				
		06/28/94	6				
		06/29/94	11				
		06/30/94	1	142			
		07/01/94	3				
		07/02/94	2				
		07/03/94	3				
		07/04/94	3				
		07/05/94	9				
		07/06/94	6				
		07/07/94	5				

BEGINNING DATE: 01/01/94
ENDING DATE: 09/31/94

SET LEV	SET NAME	DATE USED	DAY USE	MON USE	TIME TOTAL	% OF SETS	CUMULA % SETS
15	BASIC LAPAROTOMY SET	07/08/94	4				
		07/10/94	1				
		07/11/94	6				
		07/12/94	9				
		07/13/94	7				
		07/14/94	3				
		07/15/94	7				
		07/16/94	1				
		07/17/94	1				
		07/18/94	6				
		07/19/94	7				
		07/20/94	4				
		07/21/94	8				
		07/22/94	9				
		07/23/94	1				
		07/24/94	2				
		07/25/94	8				
		07/26/94	8				
		07/27/94	5				
		07/28/94	6				
		07/29/94	4		138		
		08/01/94	6				
		08/02/94	8				
		08/03/94	4				
		08/04/94	11				
		08/07/94	2				
		08/08/94	11				
		08/09/94	15				
		08/11/94	8				
		08/12/94	3				
		08/15/94	5				
		08/16/94	9				
		08/17/94	6				
		08/18/94	3				
		08/19/94	8				
		08/20/94	1				
		08/22/94	14				
		08/23/94	6				
		08/24/94	7				
		08/25/94	5				
		08/26/94	8				
		08/27/94	5				
		08/29/94	8				
		08/30/94	4				
		08/31/94	8		165		
		09/01/94	6				
		09/02/94	4				
		09/03/94	3				
		09/04/94	3				
		09/05/94	3				
		09/06/94	10				
		09/07/94	7				

BEGINNING DATE: 01/01/94
ENDING DATE: 09/31/94

SET LEV	SET NAME	DATE USED	DAY USE	MON USE	TIME TOTAL	% OF SETS	CUMULA % SETS
15	BASIC LAPAROTOMY SET	09/08/94	6				
		09/09/94	13				
		09/10/94	1				
		09/11/94	1				
		09/12/94	3				
		09/13/94	18				
		09/14/94	1				
		09/15/94	7				
		09/16/94	2				
		09/17/94	3				
		09/18/94	1				
		09/19/94	6				
		09/20/94	9				
		09/21/94	6				
		09/24/94	5				
		09/25/94	4				
		09/26/94	4				
		09/27/94	14				
		09/28/94	3				
		09/29/94	9				
		09/30/94	3	155	1409	5.48%	5.48

APPENDIX B

INSTRUMENT COUNT SHEET FOR BASIC LAPAROTOMY SET

Madigan is conducting a study of the usage of surgical instruments in this and other sets. Please complete the column labeled "Instruments used" with the number of instruments actually used in the procedure, and place this count sheet in the box labeled "Instrument Study" at the collection point in each core.

GS002_____

Basic Laparotomy Set

OR Count	OR Count	Instruments Used	CMS Count	Quantity	Instrument
					RETRACTORS:
				3	Ribbons 2" /1.5" /1"
				3	Deaver 2" /1.5" /1"
				2	Richardson **LARGE**
				2	Richardson **SMALL**
				2	Army-Navys
				2	Veins
				2	Volkmans **SHARP**
				2	Weitlaners **DULL**
					FORCEPS:
				2	Tissues 5.5"
				2	Adsons
				2	Russians 6"
				2	DeBakeys 8"
				2	DeBakeys 10"
				1	Tissue 10"
				1	Dressing 10"
				1	Bonney **(SILVER HANDLE)**
					BASIC INSTRUMENTS:
				2	Knife Handles # 3
				1	Knife Handle # 7
				1	Adson Suction
				1	Poole Suction
					STRINGED INSTRUMENTS:
				6	Mosquitoes **CURVED**
				2	Mosquitoes **STRAIGHT**
				8	Criles
				8	Kellys
				2	Rankins
				4	Allis
				4	Kochers
				2	Judd-Allis
				4	Babcocks **8"**
				2	Right Angles **7" DELICATE**
				4	Lahey-Mixters
				4	Tonsils
				2	Rochester Peons
				3	Sponge Forceps
				1	DeBakey Needle Holder **9"**
				2	Hegar Needle Holders **7"**
				2	Hegar Needle Holders **6"**
				4	**TOWEL** Clips LARGE
				2	**LINEN** Clips LARGE

Basic Laparotomy Set (continued)

OR Count	OR Count	Instruments Used	CMS Count	Quantity	Instrument
					SCISSORS:
_____	_____	_____	_____	1	Mayo **7" CURVED**
_____	_____	_____	_____	1	Mayo **7" STRAIGHT**
_____	_____	_____	_____	1	Metz **7"**
_____	_____	_____	_____	1	Nelson **9" CURVED**
_____	_____	_____	_____	1	Nelson **9" STRAIGHT**

ASSEMBLED BY _____ DATE _____
(Print last name)

COUNTED BY _____

DATE _____ ROOM _____ CASE# _____

APPENDIX C

CLINICAL INSTRUMENT INVENTORY SUMMARY

Inventory Table

15-Mar-95

Clinic	Item name	Quantity
Cardiac Cath Lab	Cable, 4-pin adapter	43
Cardiac Cath Lab	Catheter, electrophysiology study	55
Cardiac Cath Lab	Knife	2
Cardiac Cath Lab	Knife handle	2
Cardiac Cath Lab	Pacemaker tray	3
Cardiac Cath Lab	Scissors, Metzenbaum, baby	1
Cardiac Cath Lab	Tray, Cutdown	2
Cardiac Cath Lab	Tray, Pacemaker	3
CCU	Bowls, saline	9
CCU	Closed Thoracotomy tray	2
CCU	Cutdown tray	2
CCU	Hand towel	7
CCU	Minor Surgery set	2
CCU	Open Thoracotomy tray	2
CCU	Paddles, Internal	1
CCU	Tracheostomy tray	2
CTMC	Currette, ear	2
CTMC	Forcep, Adson	1
CTMC	Forceps, Dressing	1
CTMC	Forceps, sponge	4
CTMC	Minor suture set	6
CTMC	Nail clippers	1
CTMC	Scissors, Iris, curved	2
CTMC	Scope, anal	2
CTMC	Speculum, nasal	5
CTMC	Syringe, ear	1
CTMC	Towel clips	6
CTMC #5	Basin, single	1
CTMC #5	Bowls, saline	7
CTMC #5	Eye sheets	2
CTMC #5	Forcep, Adson	2
CTMC #5	Minor surgery set	2
CTMC #5	Minor suture set	8
CTMC #5	Probe, Groved director	1
CTMC #5	Probe, Lacrimal	1

Clinic	Item name	Quantity
CTMC #5	Sheet, Eye	2
CTMC #5	Speculum, Graves, medium	3
CTMC #5	Tracheostomy Tray	1
Dermatology	Bowls, saline	3
Dermatology	Bridges and Stopcock	1
Dermatology	Clamp, Chalazion	2
Dermatology	EHL cord	1
Dermatology	Excision tray	11
Dermatology	Eye sheets	2
Dermatology	Forceps, Adson	3
Dermatology	Forceps, Dressing 5"	4
Dermatology	Forceps, Iris, Tissue	1
Dermatology	Forceps, Splinter	5
Dermatology	Knife handle, #3	4
Dermatology	Knife handle, Beaver	2
Dermatology	Lyradle	1
Dermatology	Needle holder, Webster	1
Dermatology	Prep cup	1
Dermatology	Punch pack	8
Dermatology	Retractor, Codman, Liated	1
Dermatology	RUG Sets	4
Dermatology	Scissors, Iris, curved	6
Dermatology	Scissors, Iris, straight	3
Dermatology	Scissors, Lincoln, 10"	1
Dermatology	Scissors, Metzenbaum, delicate	1
Dermatology	Sound, Jewett	1
Dermatology	Sounds, Walther	3
Dermatology	TUR Basins	3
Dermatology	TUR Instruments	3
Dermatology	VBS	5
Emergency Department	Atomizer	4
Emergency Department	Basin, single	1
Emergency Department	Burr hole set	1
Emergency Department	Cannula	1
Emergency Department	Chest tube	7
Emergency Department	Clip Applier, Raney	1
Emergency Department	Closed Thoracotomy set	3
Emergency Department	Connectors, 5 in 1	6
Emergency Department	Cryco-thyroid set	4
Emergency Department	Currette	1
Emergency Department	Defibrillator, Datascope	2

Clinic	Item name	Quantity
Emergency Department	Defibrillator, Lifepack	1
Emergency Department	Drill and Bits	2
Emergency Department	Drill, Smedburg	1
Emergency Department	Endometrial Box set	1
Emergency Department	Eye droppers	2
Emergency Department	Forcep, Bayonet	6
Emergency Department	Forcep, Box	1
Emergency Department	Forcep, Brown, 10"	1
Emergency Department	Forcep, Cup	1
Emergency Department	Forcep, McGill	29
Emergency Department	Forcep, Sponge	4
Emergency Department	Forcep, Tissue	1
Emergency Department	Gardner Wells	2
Emergency Department	Hole punch	3
Emergency Department	Kirschner Wire tray	2
Emergency Department	Layrngeal mirrors	7
Emergency Department	Minor surgery set	14
Emergency Department	Nail clippers	1
Emergency Department	Needle holder, Castroviejo, strai	1
Emergency Department	Open Thoracotomy set	4
Emergency Department	Paddles, Internal	3
Emergency Department	Peritoneal set	5
Emergency Department	Retractor, Morrison	1
Emergency Department	Retractor, Weider, Tongue-blade	1
Emergency Department	Scissors, Iris, straight	1
Emergency Department	Scope, anal	5
Emergency Department	Spatula	1
Emergency Department	Speculum, Labor and Delivery	1
Emergency Department	Speculum, Vaginal	85
Emergency Department	Speculum, Veina	18
Emergency Department	Suture set	10
Emergency Department	Syringe, 10 cc	6
Emergency Department	Syringe, Dental	12
Emergency Department	Syringe, Jumbo	1
Emergency Department	Tenaculum	2
Emergency Department	Throat Packing	3
Emergency Department	Tracheostomy tubes	7
Emergency Department	Tray, Hemorrhage	3
Emergency Department	Tray, Tracheostomy	7
Emergency Department	Tray, Vaginal laceration	1
Emergency Department	Umbilical Cutdown tray	2
Emergency Department	Uterine sound	1
Emergency Department	Vein cutdown set	7
Emergency Department	Wire cutter	1

Clinic	Item name	Quantity
ENT	Bi-polar, angled	1
ENT	Bi-polar, bayonet	9
ENT	Bi-polar, straight	3
ENT	Bi-polar, Turbinate	1
ENT	Bipolar cord	1
ENT	Bite block	1
ENT	Burr, diamond, cutting	1
ENT	Cannula, 25 G	1
ENT	Clamp, Hartman	1
ENT	Clamp, Towel	1
ENT	Crile	16
ENT	Crile, straight	1
ENT	Dilators, Mahoney	1
ENT	Double basin with towels	1
ENT	Elevator, Freer	1
ENT	Elevator, Sayer	5
ENT	ENT Basic set	1
ENT	ENT Ergo Dermabrader	1
ENT	ENT Fisch drill	2
ENT	ENT flap dissectors	2
ENT	ENT Laser Mirror set	1
ENT	ENT Micro plate set	1
ENT	ENT X-minor set	2
ENT	Eye sheet	6
ENT	Foceps, Fixation	3
ENT	Forcep, Adson	11
ENT	Forcep, Belushi	6
ENT	Forcep, Castroviejo	2
ENT	Forcep, cup	2
ENT	Forcep, Dressing	4
ENT	Forcep, fixation	3
ENT	Forcep, Tissue	3
ENT	Forceps, Blakesely	2
ENT	Forceps, Kelley	3
ENT	Forceps, McGill	2
ENT	Forceps, Unipolar	2
ENT	Forceps, Washman	1
ENT	Genesis	1
ENT	Hooks, skin	7
ENT	Implantables	8
ENT	Knife handle #7	14
ENT	Knife handle, Beaver	12
ENT	Lar size 11	1
ENT	Lar size 6	1
ENT	Lar size 8	6

Clinic	Item name	Quantity
ENT	Minor surgery tray	2
ENT	Myringetomy set	3
ENT	Needle holder	1
ENT	Needle holder 5"	4
ENT	Needle holder 6"	1
ENT	Needle holder 7"	1
ENT	Needle holder, Cerwin	1
ENT	Osteotomes	2
ENT	Otoscope, 0 degrees	1
ENT	Plier, Needle nose	1
ENT	Probe, Lacrimal	6
ENT	Punch Biopsy	7
ENT	Retractor, Ribbon	1
ENT	Retractor, Weider, tongue-blade,	2
ENT	Rongeur, Takahashi	10
ENT	Ruben Morcellator	1
ENT	Scissor, Iris	1
ENT	Scissor, Iris, curved	23
ENT	Scissor, Joseph	5
ENT	Scissor, Metzenbaum	1
ENT	Scissors, ENT	1
ENT	Scissors, Mosquito	10
ENT	Scissors, Tenotomy	5
ENT	Scope, Sinus 2.7 degrees	1
ENT	Silastic sheeting	1
ENT	Silastic sheeting	3
ENT	Suction, Freer	1
ENT	Tonsil-Nasal Hemmorhage tray	1
ENT	Towels, hand	8
ENT	Trach size 0	4
ENT	Trach size 00	3
ENT	Trach size 1	3
ENT	Trach size 10 and up	4
ENT	Trach size 2	4
ENT	Trach size 3	3
ENT	Trach size 4	3
ENT	Trach size 5	1
ENT	Trach size 6	3
ENT	Trach size 7	6
ENT	Trach size 8	4
ENT	Trach size 9	4
ENT	Trach tubes	2
ENT	Tracheotomy tray	2
ENT	Trochar	2
ENT	Wire cutter	5

Clinic	Item name	Quantity
Family Practice	Anuscope	2
Family Practice	Basin, OB/GYN	1
Family Practice	Circumcision bell	3
Family Practice	Circumcision Set	4
Family Practice	Clamp, Bozeman	1
Family Practice	Clamp, Crile	2
Family Practice	Clips, Towel	6
Family Practice	Crile	1
Family Practice	Currette, cervical	1
Family Practice	Endometrial biopsy tray	1
Family Practice	Endometrial tray	5
Family Practice	Forcep, Adson	3
Family Practice	Forcep, Bayonet	3
Family Practice	Forcep, Biopsy	1
Family Practice	Forcep, Dressing	1
Family Practice	Forcep, Nail	7
Family Practice	Forcep, Sponge	14
Family Practice	Forceps, Allis	1
Family Practice	Forceps, biopsy, 7B246	5
Family Practice	Forceps, Kelly	2
Family Practice	Hooks, skin	2
Family Practice	Knife handle #3	1
Family Practice	Knife handle, Beaver	1
Family Practice	Minor surgery set	6
Family Practice	Nail pack	7
Family Practice	Needle holder	1
Family Practice	Needle holder, Brown	1
Family Practice	Pin puller	1
Family Practice	Precip pack	1
Family Practice	Punch biopsy	6
Family Practice	Retractor, vein	7
Family Practice	Retractor, Weitlander	2
Family Practice	Scissors, Mosquito, curved	7
Family Practice	Scissors, Mosquito, straight	1
Family Practice	Scissors, one point sharp	1
Family Practice	Scope, anal	2
Family Practice	Sound	5
Family Practice	Speculum, Graves, large	6
Family Practice	Speculum, Graves, medium	65
Family Practice	Speculum, Graves, small	5
Family Practice	Speculum, Pederson, large	3
Family Practice	Speculum, Pederson, medium	40
Family Practice	Speculum, Pederson, small	10
Family Practice	Suction tip	1

Clinic	Item name	Quantity
Family Practice	Suture Set	8
Family Practice	Syringe, Dental	1
Family Practice	Syringe, glass, 10cc	12
Family Practice	Tenacula	10
Family Practice	Towel clips	6
Family Practice	Tracheostomy Tray	1
Family Practice	Trumpet, Iowa	1
Family Practice	Trumpet, Irrigation	4
Family Practice	Vasectomy set	2
Family Practice	Vasectomy Tray	6
Family Practice	Vein Cutdown Tray	1
Family Practice	Water bottle	1
Family Practice	Water bottles with caps	10
General Surgery	Allis	8
General Surgery	Breast Biopsy	4
General Surgery	Forceps, Adson Tissue	5
General Surgery	Forceps, Dressing	4
General Surgery	Hand Towels	5
General Surgery	Hooks, skin	7
General Surgery	Knife Holder, Brown	2
General Surgery	Minor Surgery Set	12
General Surgery	Nail nipper	1
General Surgery	Punch Biopsy	7
General Surgery	Rake	4
General Surgery	Retractor, Army - Navy	4
General Surgery	Retractor, Weitlander, small	1
General Surgery	Scissors, Iris	10
General Surgery	Scissors, Mayo, straight	5
General Surgery	Scissors, Metzenbaum	2
General Surgery	Scissors, Mosquito, straight	2
General Surgery	Sheets, eye	6
GI Clinic	Cannula, Infusion, long	1
GI Clinic	Cannula, Irrigation	2
GI Clinic	Feeding Tubes and Trochars	3
GI Clinic	Forceps, Basket, large	1
GI Clinic	Forceps, Basket, medium	1
GI Clinic	Forceps, Basket, small	1
GI Clinic	Forceps, Biopsy, EGD K	2
GI Clinic	Forceps, Biopsy, 18115	3
GI Clinic	Forceps, Biopsy, 24M	3
GI Clinic	Forceps, Biopsy, 26N	1
GI Clinic	Forceps, Biopsy, 44NR	1
GI Clinic	Forceps, Biopsy, 74GI	1

Clinic	Item name	Quantity
GI Clinic	Forceps, Biopsy, COLON U, FG84	14
GI Clinic	Forceps, Biopsy, FB134	1
GI Clinic	Forceps, Biopsy, FB13K	5
GI Clinic	Forceps, Biopsy, FB15K	5
GI Clinic	Forceps, Biopsy, FB23K	1
GI Clinic	Forceps, Biopsy, FB244	18
GI Clinic	Forceps, Biopsy, FB24C	1
GI Clinic	Forceps, Biopsy, FB24E	18
GI Clinic	Forceps, Biopsy, FB25K	8
GI Clinic	Forceps, Biopsy, FDI4	1
GI Clinic	Forceps, Biopsy, FG 64	1
GI Clinic	Forceps, Biopsy, FG44NR	1
GI Clinic	Forceps, Biopsy, FG454	8
GI Clinic	Forceps, Biopsy, FG94	1
GI Clinic	Forceps, Biopsy, LT62805	2
GI Clinic	Forceps, Flex	1
GI Clinic	Forceps, Hot biopsy	3
GI Clinic	Laparascope, 10 degree	1
GI Clinic	Laparascope, Olympus, 0 degree	1
GI Clinic	Laparascope, Richard Wolf	1
GI Clinic	Laparoscope, Olympus, 45 degree	1
GI Clinic	Laparoscope, Olympus, 8"	1
GI Clinic	Peritonoscopy tray	3
GI Clinic	Rubber washers (package)	1
GI Clinic	Snare, Jumbo	13
GI Clinic	Snare, medium	13
GI Clinic	Snare, small	14
GI Clinic	Tube, Warner	1
GI Clinic	Water Bottle	22
GU Clinic	Biopsy needle, Gull Uson	2
GU Clinic	Bougie, Pediatric, package	1
GU Clinic	Brushes	4
GU Clinic	Catheter guide	10
GU Clinic	CFR Tubing	1
GU Clinic	Circ sets	2
GU Clinic	Clamp, Penile	2
GU Clinic	Cleaver	1
GU Clinic	Cleaver, laser	1
GU Clinic	Cotton tipped applicators	1
GU Clinic	Cystoscope, pediatric	1
GU Clinic	Dialator, Kohlman	4
GU Clinic	Dialators, Hegar	1
GU Clinic	Dialators, miscellaneos	11
GU Clinic	Dialators, Urethral	2

Clinic	Item name	Quantity
GU Clinic	Dilators, Pediatric	5
GU Clinic	Elik Adaptors	1
GU Clinic	Evacuator, Ellick	3
GU Clinic	Female Cysto set	1
GU Clinic	Filliform folllowers	6
GU Clinic	Forceps, Bayonet	2
GU Clinic	Forceps, grasping	1
GU Clinic	Forceps, Kelley	6
GU Clinic	Forceps, Lowsky	13
GU Clinic	Forceps, snares	6
GU Clinic	Graduate Pitcher, small	1
GU Clinic	GU Instrument tray	1
GU Clinic	Hand Towel	5
GU Clinic	Knife handle, #3	2
GU Clinic	Large Gown Towel	2
GU Clinic	Laser fiber 320	2
GU Clinic	Laser fiber 550	3
GU Clinic	Light cords	2
GU Clinic	Lithorite, Henderson	3
GU Clinic	Minor surgery set	1
GU Clinic	Needle holder	1
GU Clinic	Needles (flex)	6
GU Clinic	Nephroscope, flex	1
GU Clinic	Nephroscope, offset	1
GU Clinic	Otis tip	1
GU Clinic	Otis Urethrotome	1
GU Clinic	Pan, soak, large	7
GU Clinic	Pan, soak, small	2
GU Clinic	Pediatric GU Instrument set	2
GU Clinic	Probe, ultrasonic	3
GU Clinic	Resectoscope, (old series)	1
GU Clinic	Resectoscope, (USA series)	1
GU Clinic	Resectoscope, pediatric	6
GU Clinic	Retractor, Wright	1
GU Clinic	Scissor, Mosquito, curved	9
GU Clinic	Scissors, Iris, curved	1
GU Clinic	Scissors, Iris, straight	3
GU Clinic	Scissors, Mayo	3
GU Clinic	Scissors, Metzenbaum	2
GU Clinic	Scissors, Mosquito, curved	9
GU Clinic	Silastic tubing CBD	8
GU Clinic	Speculum, Graves, medium	6
GU Clinic	Speculum, vaginal	6
GU Clinic	Stopcock	1
GU Clinic	Syringe, Eluk bulb	4

Clinic	Item name	Quantity
GU Clinic	Syringe, glass	4
GU Clinic	Toomey Catheter tips	2
GU Clinic	Tray, Tracheostomy	1
GU Clinic	Urethropexy set	1
GU Clinic	Urethrotome, Otis	1
GU Clinic	Vasectomy set	5
Intermediate ICU	Bowls, saline	4
Intermediate ICU	Catheterization set	3
Intermediate ICU	Cotton roll	1
Intermediate ICU	Cryco-thyroid tray	2
Intermediate ICU	Forceps, McGill	2
Intermediate ICU	Forceps, Sponge	4
Intermediate ICU	Forceps, Tissue	4
Intermediate ICU	Hand drill, Reese	1
Intermediate ICU	Minor surgery set	1
Intermediate ICU	Minor suture set	2
Intermediate ICU	Peritoneal set	1
Intermediate ICU	Sheet, eye	11
Intermediate ICU	Speculum, Graves, large	2
Intermediate ICU	Speculum, Graves, medium	2
Intermediate ICU	Speculum, Graves, small	2
Intermediate ICU	Speculum, Nasal	2
Intermediate ICU	Tracheostomy tray	2
Intermediate ICU	Vein cut down tray	2
Internal Medicine	Anoscope	1
Internal Medicine	Forceps, Biopsy, (blue handle/bla	1
Internal Medicine	Forceps, Biopsy, KW2411S	3
Internal Medicine	Speculum, Graves, large	11
Internal Medicine	Speculum, Graves, medium	59
Internal Medicine	Speculum, Graves, small	7
Internal Medicine	Speculum, Pedersons, large	16
Internal Medicine	Speculum, Pedersons, medium	63
Internal Medicine	Water bottles with caps	5
Labor and Delivery	Basin, single	1
Labor and Delivery	Bilateral Tubal Ligation (BTL) ca	1
Labor and Delivery	Bowl, OB/GYN	23
Labor and Delivery	Bowls, OB/GYN	11
Labor and Delivery	C-section cart	4
Labor and Delivery	Clamp, 4 point sharp, bent	1
Labor and Delivery	Clamp, Allis	1
Labor and Delivery	Clamp, Allis, bent	2
Labor and Delivery	Clamp, Babcock	1

Clinic	Item name	Quantity
Labor and Delivery	Clamp, Rankin	1
Labor and Delivery	Clamp, Right-angle	1
Labor and Delivery	Cups, preparatory	2
Labor and Delivery	Currette, GYN	5
Labor and Delivery	Deaver retractor set	2
Labor and Delivery	Deschamp ligature carrier	1
Labor and Delivery	Dialators, Hegar	3
Labor and Delivery	Dilation and Currettage (D & C) c	1
Labor and Delivery	Double basin with towels	2
Labor and Delivery	Forcep, Baby Simpson	4
Labor and Delivery	Forcep, Bailey	5
Labor and Delivery	Forcep, Elliot	2
Labor and Delivery	Forcep, Freeman	6
Labor and Delivery	Forcep, Go left	1
Labor and Delivery	Forcep, Hauk-Dennin	1
Labor and Delivery	Forcep, Hawk	1
Labor and Delivery	Forcep, Kielland	7
Labor and Delivery	Forcep, Laufe	5
Labor and Delivery	Forcep, Leff	2
Labor and Delivery	Forcep, Piper	11
Labor and Delivery	Forcep, Simpson	3
Labor and Delivery	Forcep, Tieman	5
Labor and Delivery	Forcep, Tucker	4
Labor and Delivery	Forcep, Tucker-Lukehart	2
Labor and Delivery	Forceps, Bonny	1
Labor and Delivery	Forceps, Bozeman	8
Labor and Delivery	Forceps, DeBakey 10"	3
Labor and Delivery	Forceps, Dressing	1
Labor and Delivery	Forceps, King	10
Labor and Delivery	Forceps, Lieman	6
Labor and Delivery	Forceps, Lucker	4
Labor and Delivery	Forceps, Russian 5"	1
Labor and Delivery	Forceps, Russian 8"	1
Labor and Delivery	Hand towels	60
Labor and Delivery	Knife handle #7	1
Labor and Delivery	Needle holder, Heaney	4
Labor and Delivery	Plastic bags	1
Labor and Delivery	Precip pack	29
Labor and Delivery	Prep cups	3
Labor and Delivery	PUD set	1
Labor and Delivery	Retractor, Army-Navy	2
Labor and Delivery	Retractor, Balfour	1
Labor and Delivery	Retractor, Bladder blade	1
Labor and Delivery	Retractor, Breisky	2
Labor and Delivery	Retractor, Eastman	3

Clinic	Item name	Quantity
Labor and Delivery	Retractor, Gelpi	3
Labor and Delivery	Retractor, Ribbon	3
Labor and Delivery	Retractor, Richardson	1
Labor and Delivery	Retractor, Saurbach	2
Labor and Delivery	Retractor, Simms	10
Labor and Delivery	Retractor, vein	1
Labor and Delivery	Retractor, Weitlander	1
Labor and Delivery	Scissors, bandage	1
Labor and Delivery	Scissors, Mayo, curved	3
Labor and Delivery	Scissors, Mayo, straight	2
Labor and Delivery	Scissors, Metzenbaum	2
Labor and Delivery	Scissors, Metzenbaum 10"	1
Labor and Delivery	Scissors, one point sharp	1
Labor and Delivery	Single basin	1
Labor and Delivery	Speculum, Graves, large	7
Labor and Delivery	Speculum, Graves, medium	45
Labor and Delivery	Speculum, Graves, small	14
Labor and Delivery	Speculum, Pederson, medium	2
Labor and Delivery	Sponges, Stick	1
Labor and Delivery	Swabs, Procto	3
Labor and Delivery	Tenacula, Braun	7
Labor and Delivery	Tenacula, Jacobs	1
Labor and Delivery	Tray, neonatal emergency	3
Labor and Delivery	Tray, UAC	3
Labor and Delivery	Tray, vaginal laceration	1
Labor and Delivery	Uterine sound	2
Labor and Delivery	Vaginal delivery carts	7
Labor and Delivery	Vaginal laceration tray	1
NICU	Circumcision Set	11
NICU	Clips, Towel	5
NICU	Forcep, Adson	1
NICU	Forcep, McGill, large	1
NICU	Forcep, McGill, small	2
NICU	Forcepe, McGill, pediatric	1
NICU	Hooks, skin	4
NICU	Knife handle #3	1
NICU	Neonatal Emergency tray	1
NICU	NICU chest tube tray	1
NICU	Scissors, Tenotomy	1
NICU	Towel clips	5
NICU	Trach tube	1
NICU	Tray, neonatal emergency	1
NICU	Tube, Tracheostomy	1
NICU	Umbilical cutdown tray	5

OB/GYN	Cannula	15
OB/GYN	Curette, Novak	3
OB/GYN	Currette, Kevorkien	32
OB/GYN	Dialators, Hank	1
OB/GYN	Dialators, Heancy	1
OB/GYN	Endometrial tray	6
OB/GYN	Forceps, Adson	19
OB/GYN	Forceps, Bayonet	11
OB/GYN	Forceps, Bothon tying	1
OB/GYN	Forceps, Box	1
OB/GYN	Forceps, Bozeman	24
OB/GYN	Forceps, Cin shear	1
OB/GYN	Forceps, dressing, 10"	40
OB/GYN	Forceps, Fletcher Van Doren Polyp	1
OB/GYN	Forceps, Iris dressing	2
OB/GYN	Forceps, Kelly, curved	3
OB/GYN	Forceps, Kevorkien	53
OB/GYN	Forceps, Potts-Smith, dressing	8
OB/GYN	Forceps, sponge	75
OB/GYN	Graduate, small	4
OB/GYN	Hemostat, curved	3
OB/GYN	Hemostat, straight	9
OB/GYN	Hystoscope	1
OB/GYN	Knife handle	9
OB/GYN	Minor Surgical tray	5
OB/GYN	Needle holder, Baumgartner, small	7
OB/GYN	Needle holder, Rubio, large	7
OB/GYN	Obturator and sheath	12
OB/GYN	Precipitation pack	2
OB/GYN	Probe and Grove Director	2
OB/GYN	Probe, Lacrimal	17
OB/GYN	Scissors, Iris, curved	13
OB/GYN	Scissors, Iris, straight	3
OB/GYN	Speculum, Endocervical	32
OB/GYN	Speculum, Graves, large	62
OB/GYN	Speculum, Graves, medium	358
OB/GYN	Speculum, Graves, small	6
OB/GYN	Speculum, Leep	16
OB/GYN	Speculum, Leep, endocervical	6
OB/GYN	Speculum, nasal	1
OB/GYN	Speculum, Pederson, large	17
OB/GYN	Speculum, Pederson, medium	132
OB/GYN	Speculum, Pederson, small	27
OB/GYN	Spinal needle	2

Clinic	Item name	Quantity
OB/GYN	Syringe, 3 ring, 10 cc	11
OB/GYN	Tenacula, Braun	74
OB/GYN	Tonsil needle	2
OB/GYN	Tonsil snares	1
OB/GYN	Trumpet, Iowa	12
OB/GYN	Urethroscope, Fiberoptic, 0 degre	4
OB/GYN	Urethroscope, Fiberoptic, 70 degr	2
OB/GYN	Urethroscope, Fiberoptic, short R	1
OB/GYN	Urethroscope, light cord	4
OB/GYN	Uretine sound	87
Opthamology	Adjustable suture set	3
Opthamology	Bovie and cords	2
Opthamology	Cannula, McIntyre	7
Opthamology	Chalizon set	4
Opthamology	Clamp, eyelid	1
Opthamology	Clamp, Towel	2
Opthamology	Clamps, Chalazion	3
Opthamology	Curette	5
Opthamology	Forceps, Castroviejo	4
Opthamology	Forceps, Dressing	1
Opthamology	Forceps, eye	8
Opthamology	Forceps, Jewelers	19
Opthamology	Hartman, Mosquito, curved	1
Opthamology	Hooks, skin	2
Opthamology	Knife handle, #3	1
Opthamology	Knife handle, Beaver	1
Opthamology	Knife handle, Brown	1
Opthamology	Knife handle, eye	10
Opthamology	Lacrimal Probe set	3
Opthamology	Lid set	4
Opthamology	Micron handle and Knife set	1
Opthamology	Minor eye set	2
Opthamology	Probe	1
Opthamology	Probe, Laser	1
Opthamology	Radial Kerotomy set	2
Opthamology	Scissors	8
Opthamology	Spatula	3
Opthamology	Speculum, eye	1
Orthopedic	Bowls, saline	2
Orthopedic	Bunnell Drill	1
Orthopedic	Currette	12
Orthopedic	Currette, bone	6
Orthopedic	Elevator, Freer	23

Clinic	Item name	Quantity
Orthopedic	Eye sheet	1
Orthopedic	Forcep, Adson	19
Orthopedic	Forcep, angled	1
Orthopedic	Forcep, Bayonet	1
Orthopedic	Forcep, dressing	9
Orthopedic	Forcep, Kelly	1
Orthopedic	Forceps, Bonny	1
Orthopedic	Forceps, Brown	3
Orthopedic	Forceps, Splinter	5
Orthopedic	Forceps, sponge	14
Orthopedic	Hand towel pack	1
Orthopedic	Hook, Skin	13
Orthopedic	Kirshner wire set	1
Orthopedic	Knife handle, #3	19
Orthopedic	Knife handle, Beaver	19
Orthopedic	Minor surgery set	1
Orthopedic	Minor suture set	2
Orthopedic	Nail clipper	2
Orthopedic	Nail cutter	1
Orthopedic	Nail packs	12
Orthopedic	Needle driver	1
Orthopedic	Needle holder, 7"	3
Orthopedic	Needle holder, Brown	1
Orthopedic	Needle holder, Webster	1
Orthopedic	Needle holder, Webster	3
Orthopedic	Pin cutter	1
Orthopedic	Rankin	6
Orthopedic	Retractor, Bow	1
Orthopedic	Retractor, Mastoid	1
Orthopedic	Retractor, Sens	4
Orthopedic	Retractor, vein	1
Orthopedic	Rongeur	3
Orthopedic	Scissor, Iris, straight	1
Orthopedic	Scissors, Iris, curved	9
Orthopedic	Scissors, Iris, straight	3
Orthopedic	Scissors, Mayo	1
Orthopedic	Scissors, Mayo, curved 7"	1
Orthopedic	Scissors, Mosquito	42
Orthopedic	Scissors, Mosquito, straight	36
Orthopedic	Scissors, Mosquitoes, curved	25
Orthopedic	Scissors, one point sharp	7
Orthopedic	Scissors, Tenotomy, curved	3
Orthopedic	Scissors, Tenotomy, straight	2
Orthopedic	Screwdriver	6
Orthopedic	Screwdriver, hex	1

Clinic	Item name	Quantity
Orthopedic	Screwdriver, large AO	1
Orthopedic	Screwdriver, small AO	1
Orthopedic	Smedburg Drill	1
Orthopedic, cast room	Bunnell Drill	1
Orthopedic, cast room	Currette	3
Orthopedic, cast room	Elevator, Freer	4
Orthopedic, cast room	Forcep, Adson	1
Orthopedic, cast room	Forcep, Bayonet	6
Orthopedic, cast room	Forcep, dressing	10
Orthopedic, cast room	Hook, skin	1
Orthopedic, cast room	Knife handle #3	15
Orthopedic, cast room	Knife handle, Beaver, long	1
Orthopedic, cast room	Minor suture set	4
Orthopedic, cast room	Miscellaneous screw packages	5
Orthopedic, cast room	Nail cutter	2
Orthopedic, cast room	Pin cutter	1
Orthopedic, cast room	Pin puller	11
Orthopedic, cast room	Rasp	1
Orthopedic, cast room	Retractor, Heiss	1
Orthopedic, cast room	Rongeur	2
Orthopedic, cast room	Scissor, Iris, curved	1
Orthopedic, cast room	Scissor, Mayo	1
Orthopedic, cast room	Scissor, one point sharp	9
Orthopedic, cast room	Towel clip	3
Orthopedic, cast room	Wrench, "T" handle	4
Pathology	Currettes	12
Pathology	Elevator, Freer	16
Pathology	Forceps, Splinter	5
Pathology	Hooks, skin	5
Pathology	Knife handle #3	14
Pathology	Knife handle, Beaver	19
Pathology	Nail clipper	2
Pathology	Nail cutter	1
Pathology	Nail packs	12
Pathology	Needle driver	1
Pathology	Needle holder, Brown	1
Pathology	Needle holder, Webster	1
Pathology	Pliers, needlenose, duckbill	1
Pathology	Scissors, Iris, curved	9
Pathology	Scissors, Iris, straight	3
Pathology	Scissors, Mosquitoes	22
Pathology	Scissors, Mosquitoes, straight	23
Pathology	Scissors, one point sharp	4

Clinic	Item name	Quantity
Pathology	Scissors, Tenotomy, curved	1
Pathology	Screwdriver, Hex	1
Pediatric Adolescent clinic	Clamp, Bozeman	1
Pediatric Adolescent clinic	Bowls, saline, pediatric	5
Pediatric Adolescent clinic	Forceps, Kelly	1
Pediatric Adolescent clinic	Speculum, Pedersons, large	14
Pediatric Adolescent clinic	Speculum, Pedersons, medium	28
Pediatric Adolescent clinic	Speculum, Pedersons, small	13
Plastic surgery	Bowls, saline	2
Plastic surgery	Carpenter's pencils	2
Plastic surgery	Currette	1
Plastic Surgery	Forcep, Adson - Brown	5
Plastic surgery	Forcep, Adson, smooth-jawed	2
Plastic surgery	Forcep, Adson, tissue	7
Plastic surgery	Forceps, Bayonet	2
Plastic Surgery	Forceps, Castroviejo, 0.5	2
Plastic Surgery	Forceps, Sponge	2
Plastic Surgery	Hand towels	1
Plastic Surgery	Hooks, Guthrie	1
Plastic surgery	Knife handle #3	2
Plastic Surgery	Knife handle, Beaver	2
Plastic surgery	Knife handle, Gillies	1
Plastic Surgery	Knife handle, gold handle	2
Plastic surgery	Knife handle, Webster	1
Plastic surgery	Knife, Weck	1
Plastic surgery	Minor plastic set	3
Plastic surgery	Retractor, Army/Navy	1
Plastic Surgery	Retractors, Weitlander, small	1
Plastic surgery	Scissors, Mayo, curved, 7"	1
Plastic Surgery	Scissors, Metzenbaum	1
Plastic surgery	Scissors, Mosquitoes, curved	6
Plastic surgery	Scissors, Mosquitoes, straight	2
Plastic surgery	Speculum, nasal	5
Plastic surgery	Sponges	2
Radiation Therapy	Anoscope	2
Radiation Therapy	Bronchial Implant device	1
Radiation Therapy	Clamp, radiation	1
Radiation Therapy	Delclose Tray	1
Radiation Therapy	Fletcher - Switt Tray	1
Radiation Therapy	Fletcher - Switt/Delclose Tray	2
Radiation Therapy	Forceps, Dressing, 10"	6
Radiation Therapy	Forceps, Tissue, 5"	1

Clinic	Item name	Quantity
Radiation Therapy	Guide, hollow	1
Radiation Therapy	GYN template Obturator	1
Radiation Therapy	GYN template with Obturator	1
Radiation Therapy	GYN template without Obturator	1
Radiation Therapy	Henschke Cervical Applicator Tray	1
Radiation Therapy	Needle holder, 10"	1
Radiation Therapy	Needle holder, 8"	1
Radiation Therapy	Package, buttons or caps	0
Radiation Therapy	Package, buttons, dummy catheter,	1
Radiation Therapy	Package, screws	1
Radiation Therapy	Rectal template	2
Radiation Therapy	Scissors, Iris, curved	1
Radiation Therapy	Scissors, Iris, straight	1
Radiation Therapy	Scissors, Metzenbaum	1
Radiation Therapy	Scissors, Mosquitoes, curved	3
Radiation Therapy	Scissors, one point sharp	1
Radiation Therapy	Seed implanter (and seeds)	7
Radiation Therapy	Speculum, Graves, small	1
Radiation Therapy	Speculum, open mouth	1
Radiation Therapy	Suture set	1
Radiation Therapy	Syed Needles	1
Radiation Therapy	Syed Template Tray	1
Radiation Therapy	Teflon guides	1
Radiation Therapy	Tenacula, brain	1
Radiation Therapy	Urethral template	1
Radiology/Mammography	Forceps, Biopsy, 23K	3
Radiology/Mammography	Forceps, Biopsy, 25K	4
Radiology/Mammography	Forceps, Biopsy, Cook Pediatric	2
Radiology/Mammography	Forceps, Sponge	26
Radiology/Mammography	Guides, Biopsy	64
Radiology/Mammography	Scissor, Mosquito, curved	29
SICU	Bowls, saline	5
SICU	Closed Thoracotomy Tray	3
SICU	Cryco-thyroid tray	1
SICU	Cutdown set	1
SICU	ER Peritoneal set	1
SICU	Hand towel	4
SICU	Laryngscope	1
SICU	Laryngscope Blade, long	3
SICU	Laryngscope Blade, medium	4
SICU	Laryngscope Blade, small straight	1
SICU	Open Thoracotomy Tray	1
SICU	Paddles, Internal	1

Clinic	Item name	Quantity
SICU	Speculum, nasal	1
SICU	Tracheostomy tray	2

Total Instruments: 4581

APPENDIX D

DESCRIPTIVE STATISTICS FOR PHASE 2

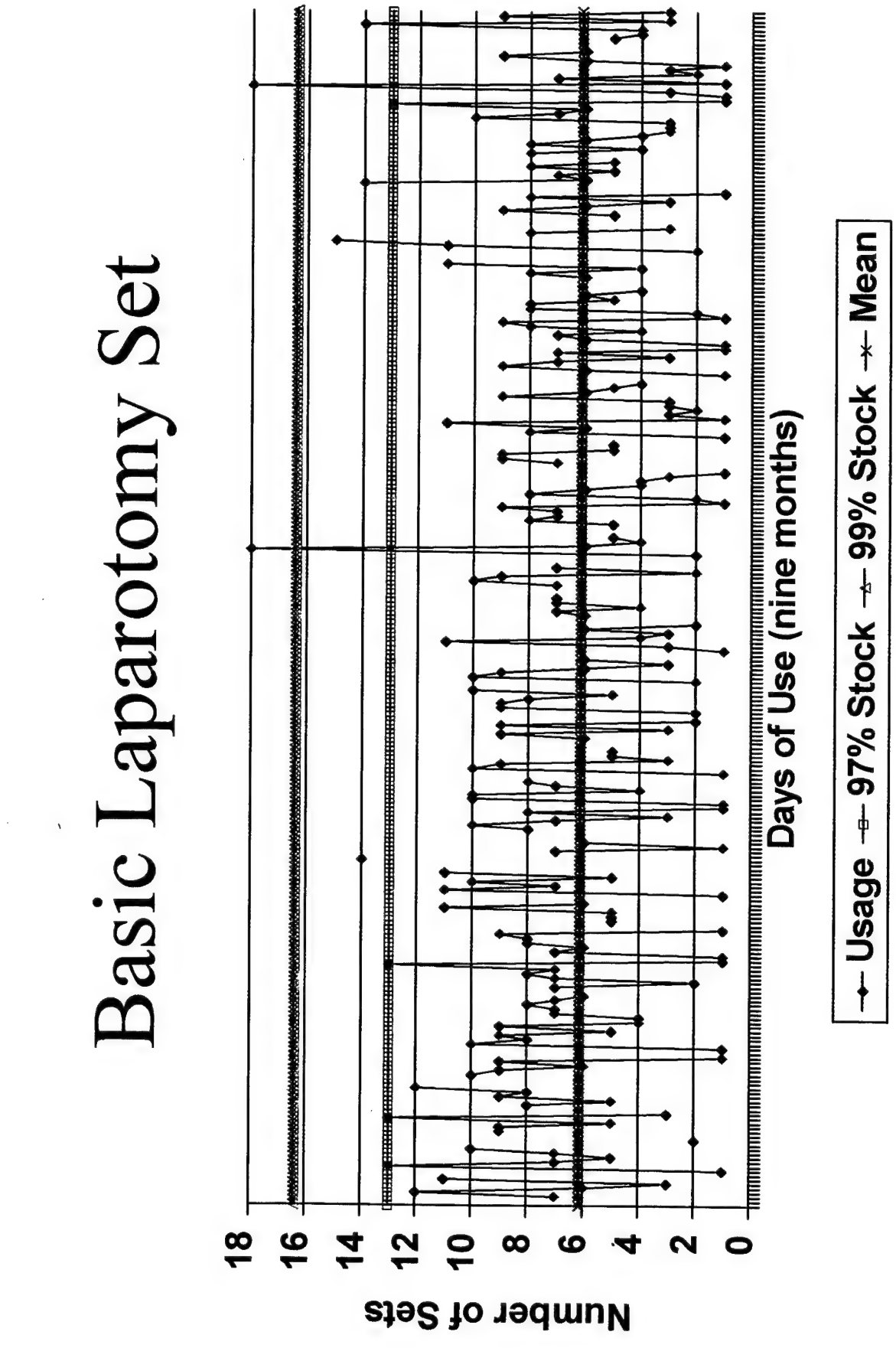
Nomenclature of Instrument Set	Total Use	"Used Days" Mean	"Used Days" Standard Deviation
BASIC LAPAROTOMY SET	1409	6.15	3.41
OB INSTRUMENT/DOUBLE BASIN SET	968	4.21	2.86
MINOR SURGERY SET	678	3.73	2.49
BASIC ORTHO SET	640	2.95	1.92
HAND SET	525	3.18	2.27
LARYNGEAL MIRRORS	436	3.07	1.67
LAMBOTTE OSTEOTOMES	430	2.32	1.35
C-SECTION SET	421	2.25	2.06
BOOKWALTER W/LARGE OVAL/ROUND RINGS	420	2.23	1.42
MINI DRIVER	410	2.29	1.36
LAPAROSCOPIC BASIC TRAY	399	2.98	1.99
LIGACLIP APPLIER LONG STRAIGHT	397	2.42	1.34
MYRINGOTOMY SET	387	5.78	6.35
GI SPECIALS	363	2.03	1.34
EYE MICROSCOPE (WILD) HANDLE COVERS	351	3.13	1.92
T&A SET	349	2.75	1.37
MCINTYRE CANNULA SET	338	3.02	1.77
LAPAROSCOPE ANY DIAG 10MM/0DEG	335	2.64	1.70
VASCULAR NEEDLE HOLDERS	329	2.28	1.30
CONCEPT INTRA-ARC SHAVER SYSTEM	327	2.32	1.23
HASSON INSTRUMENTS	320	2.74	1.73
ARTHROSCOPE WOLF 4MM/25 DEG	318	2.29	1.22
NASAL PREP SET	314	2.53	1.41
ENT SEPTO-RHINOPLASTY SET	313	2.54	1.41
DELICATE EXTRAS	306	2.01	1.41
D&C SET	294	2.21	1.60
CATARACT SET	283	2.67	1.74
GYN SPECIALS SET	275	2.20	1.28
STEINMAN PIN SET SMOOTH	275	1.81	1.10
LIGACLIP APPLIER LONG ANGLED	254	2.00	1.09
BUNION SET	244	2.77	1.47
PHACO INSTRUMENT	244	2.54	1.63
GENERAL SURGERY ENDOSCOPY SET	243	1.79	0.88
LAPAROSCOPE OLYMPUS DIAG 10MM/0DEG	222	1.75	0.89
ARTHROSCOPY INSTRUMENT SET	221	1.87	1.01
GYN ENDOSCOPY INSTRUMENTS	214	1.91	1.38
HALL STERNAL SAW	208	1.63	0.76
BABY LAPAROTOMY SET	203	1.72	0.94
OPEN HEART CHEST TRAY	200	1.57	0.73
MAXI DRIVER	198	1.57	0.93
BALFOUR RETRACTOR	195	1.84	0.96
OPEN HEART LEG TRAY	193	1.53	0.71
COBB ELEVATOR SET	191	1.62	0.89
VASCULAR SCISSOR SET	189	1.72	0.91
FOGARTY CLAMP SET	177	1.70	0.90
SIEMANS INTERNAL DEFIB PADDLES	172	1.56	0.72
CORONARY SPECIALS	172	1.48	0.68
RHOTON DISSECTOR TRAY	171	1.66	0.96
OPEN HEART FAVOLORO RETRACTOR	168	1.45	0.66
ENT BASIC SET	160	1.76	1.06
RICHARDS CURRETTE SET	157	1.43	0.67
TVH SET	154	1.69	1.06

Nomenclature of Instrument Set (continued)	Total Use	"Used Days" Mean	"Used Days" Standard Deviation
NEURO BACK SET	148	1.64	0.78
BTL ENDOSCOPY SET	145	2.12	1.27
NEURO RONGEUR PAN	139	1.48	0.71
THORACOTOMY RETRACTORS	127	1.49	0.71
ENT SOFT TISSUE SET	126	1.56	0.77
THORACOTOMY SPECIALS	126	1.54	0.74
MIDDLE EAR SPECIALS	124	1.85	0.98
VASCULAR GRAFT SET	123	1.48	0.75
MIDDLR EAR EXTRAS	121	1.83	0.90
RECTAL SET	119	1.38	0.61
JAKO MICRO-LARYNGEAL BX SET (NEW)	113	1.61	1.03
DEBAKEY DIALATORS - LONG	109	1.54	0.77
AO SMALL FRAGMENT SET	107	1.32	0.56
AO PLATE BENDING PRESS	106	1.19	0.42
LID/BLEPHAROPLASTY SET	106	1.80	0.88
AO BONE REDUCTION FORCEPS	102	1.31	0.58
LARGE VASCULAR SET	98	1.26	0.59
URETHROPEXY/COLPOPEXY SET	97	1.54	0.91
SCOVILLE RETRACTOR	95	1.28	0.58
SHOULDER REPAIR SET	91	1.32	0.63
ACL RECONSTRUCTION SET	89	1.31	0.60
OS MINOR SET	89	1.75	1.25
SMALL VASCULAR SET	89	1.33	0.58
ACUFEX DRILL SYSTEM	88	1.31	0.60
HEIFETZ CLIP APPLIER/BULLDOGS	86	1.37	0.62
K-WIRE SET	86	1.54	1.03

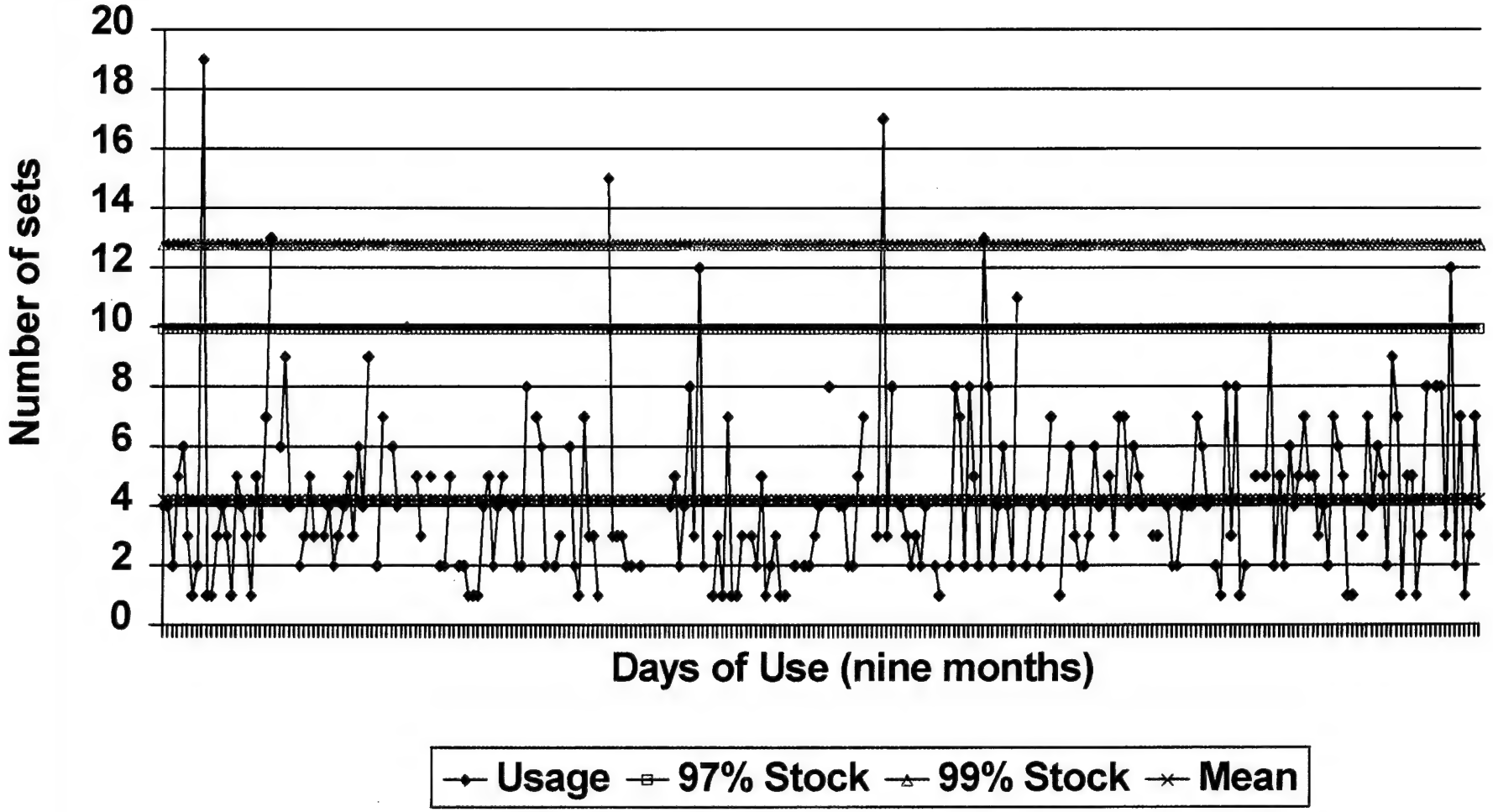
APPENDIX E

X-BAR RUN CHARTS FOR TOP 80 INSTRUMENT SETS

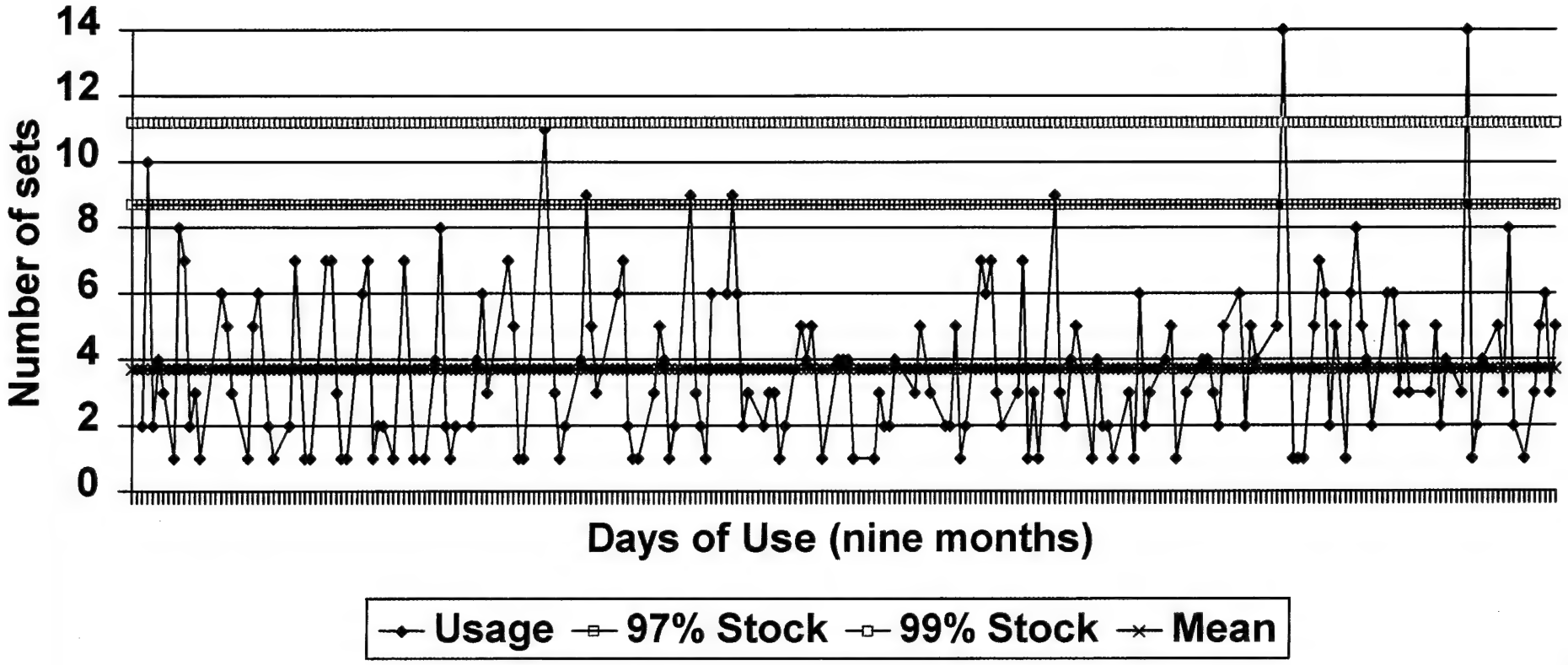
Basic Laparotomy Set



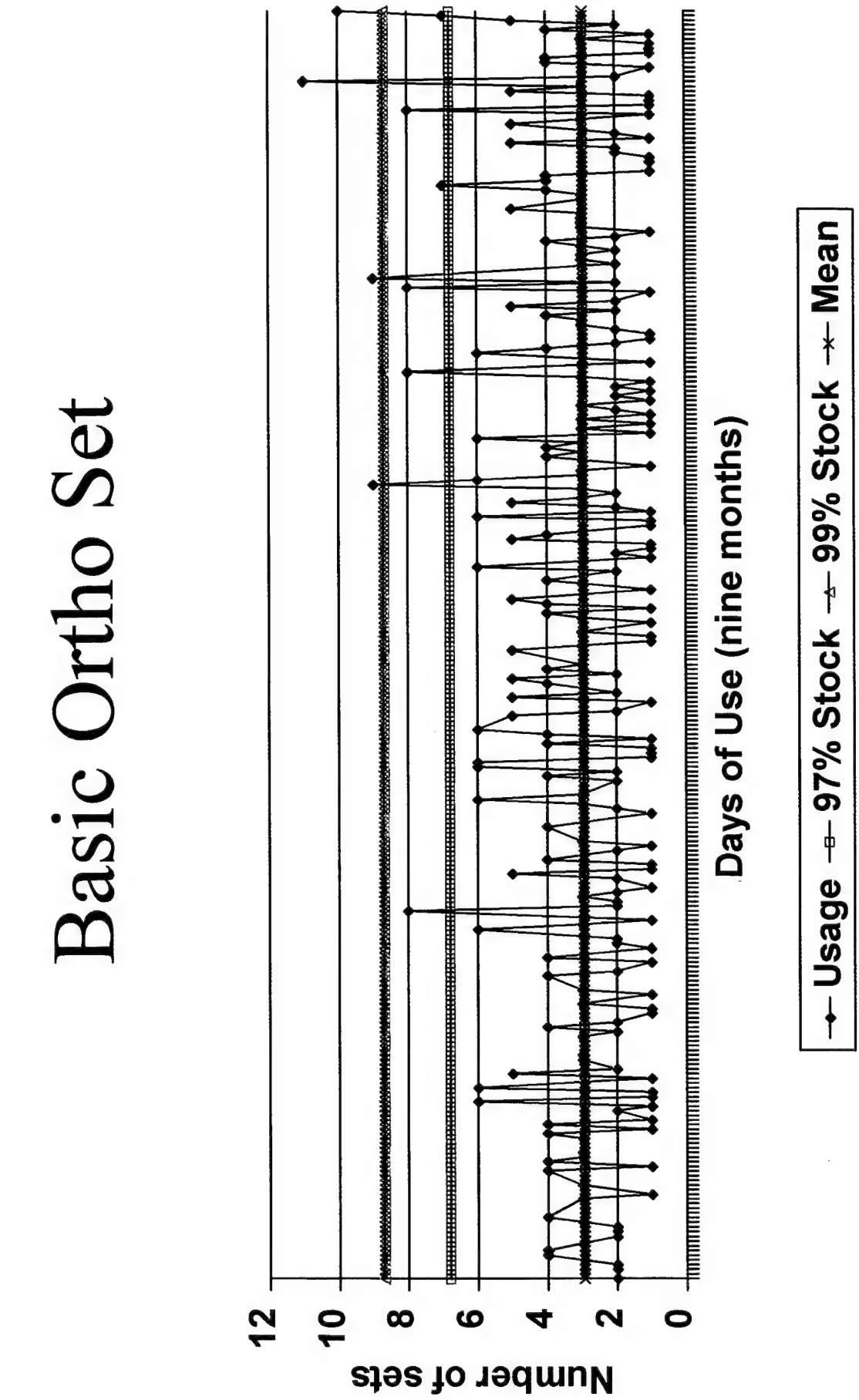
OB Instrument/Double Basin Set



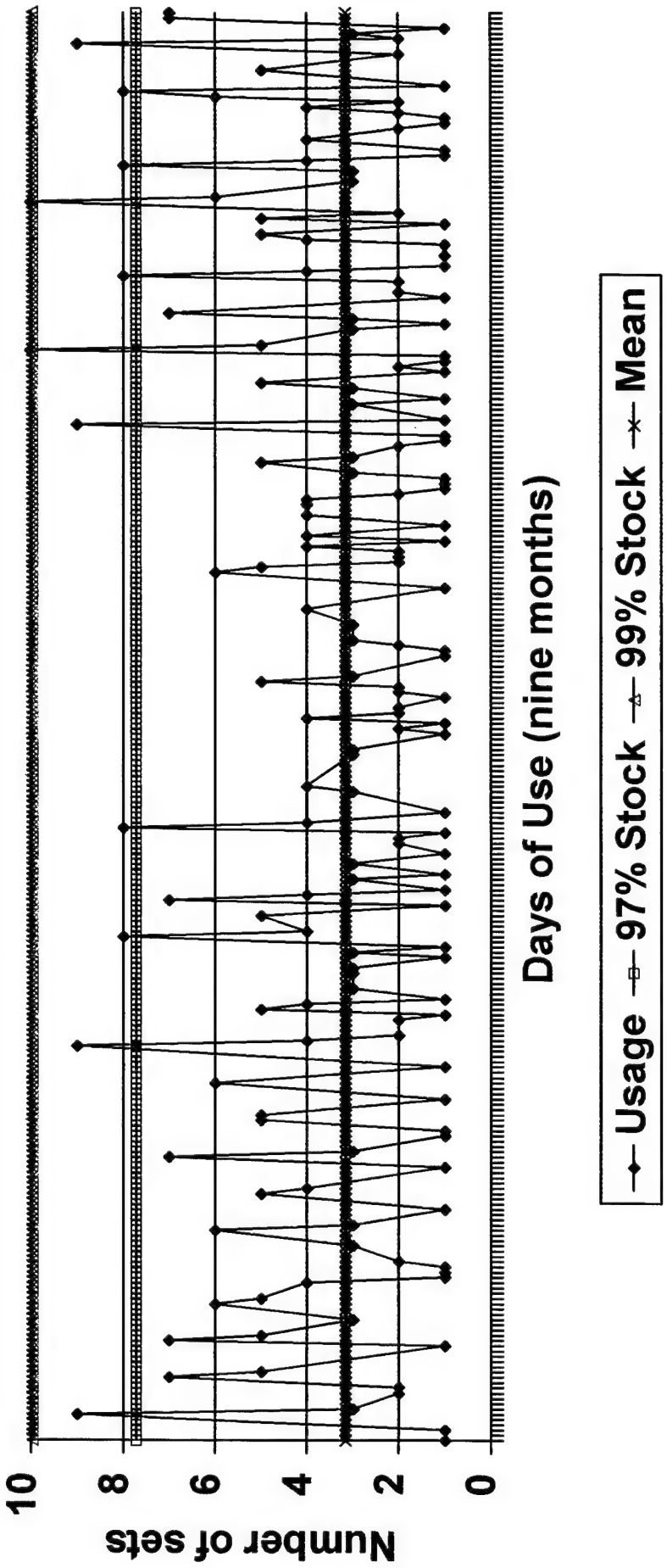
Minor Surgery Set



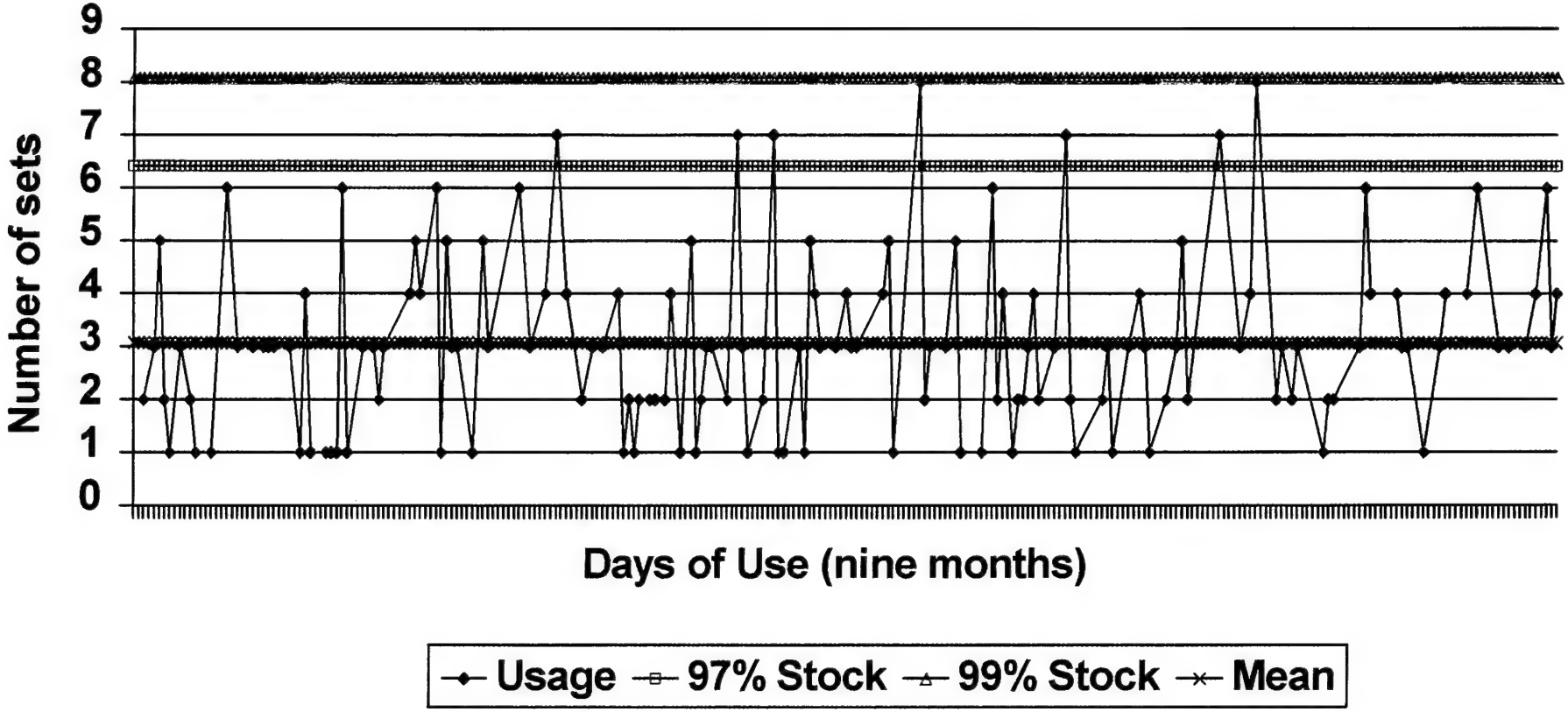
Basic Ortho Set



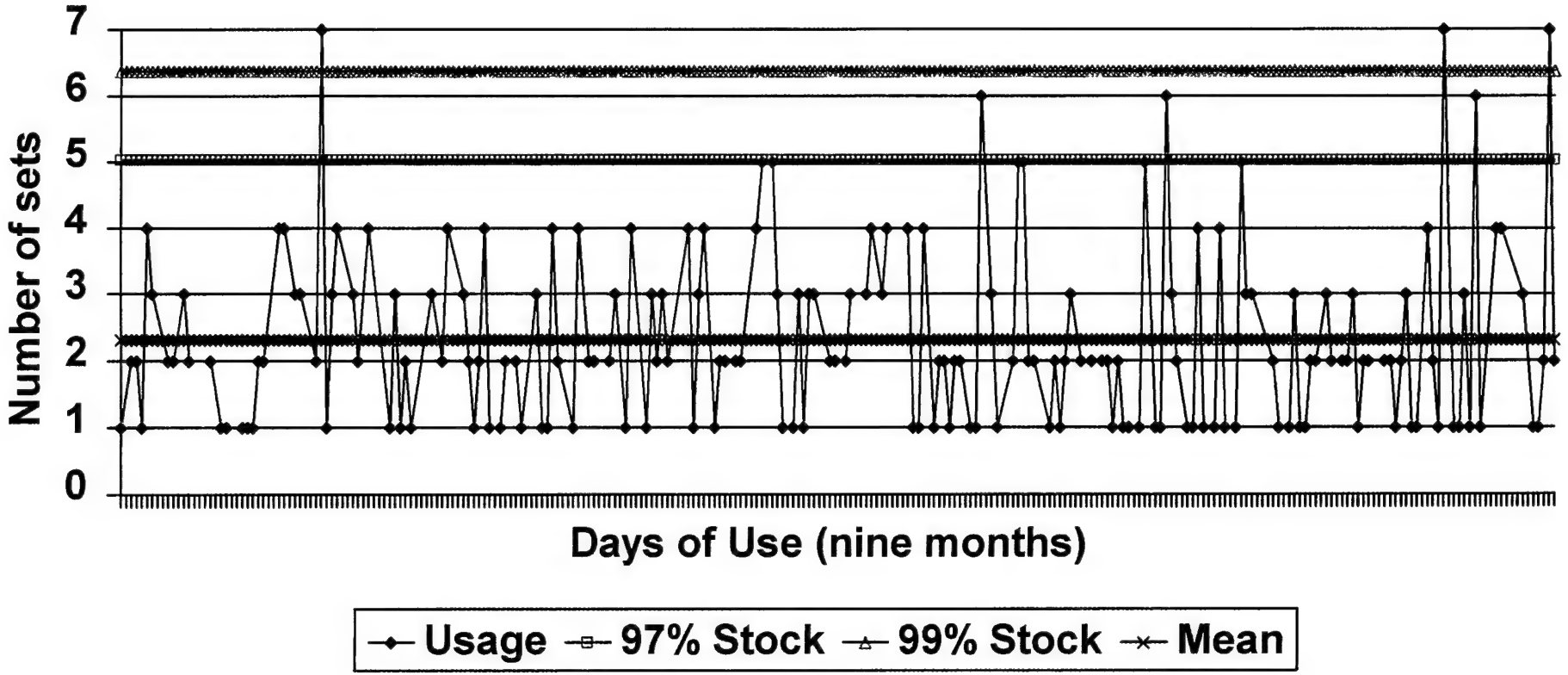
Hand Set


Number of sets
10
8
6
4
2
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

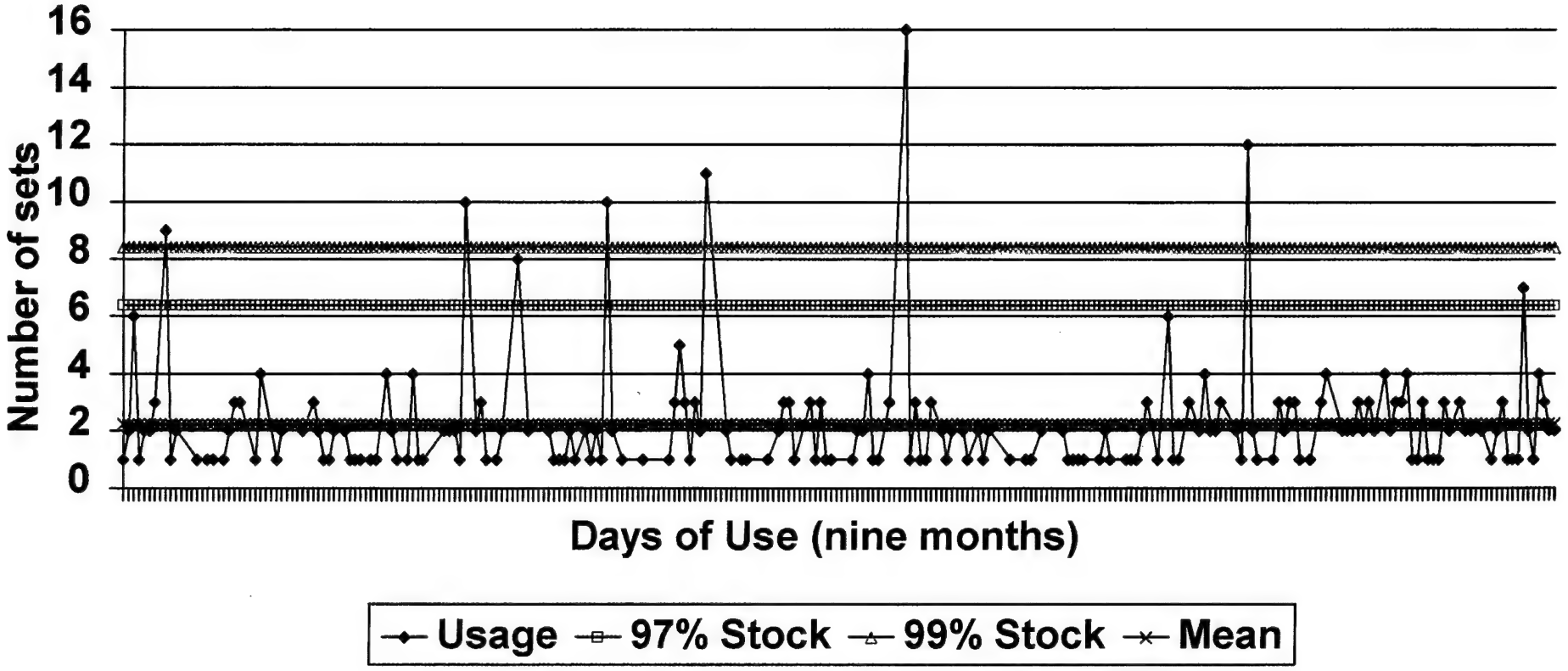
Laryngeal Mirrors



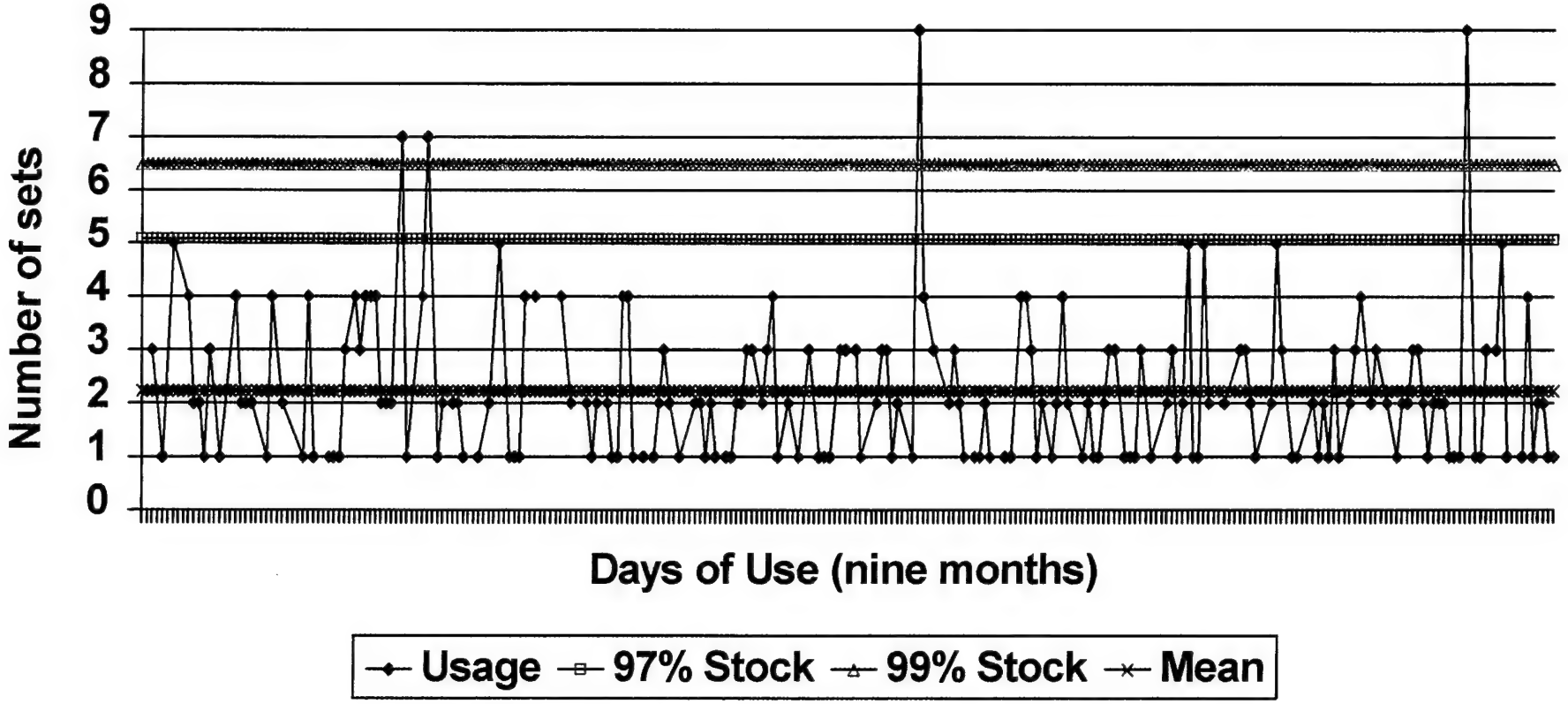
Lambotte Osteotomes



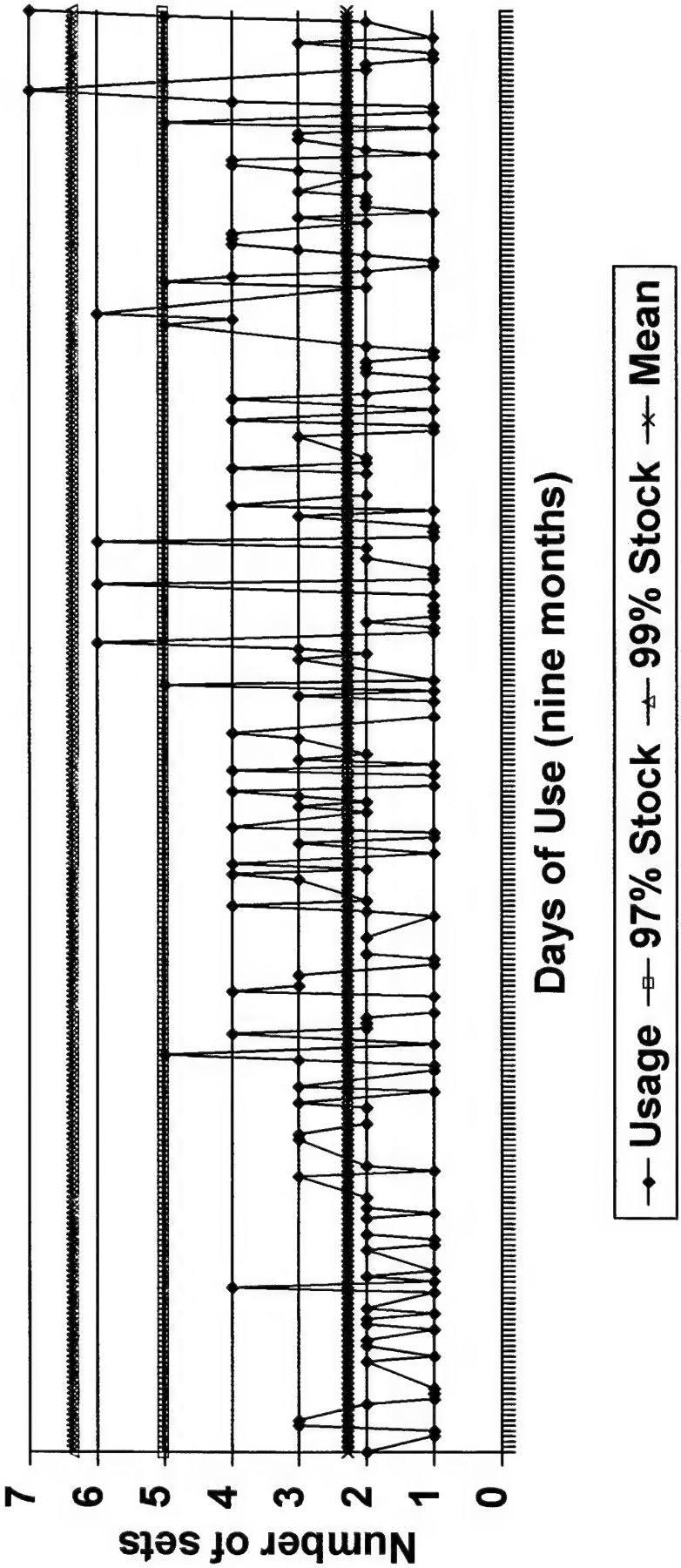
C-section Set

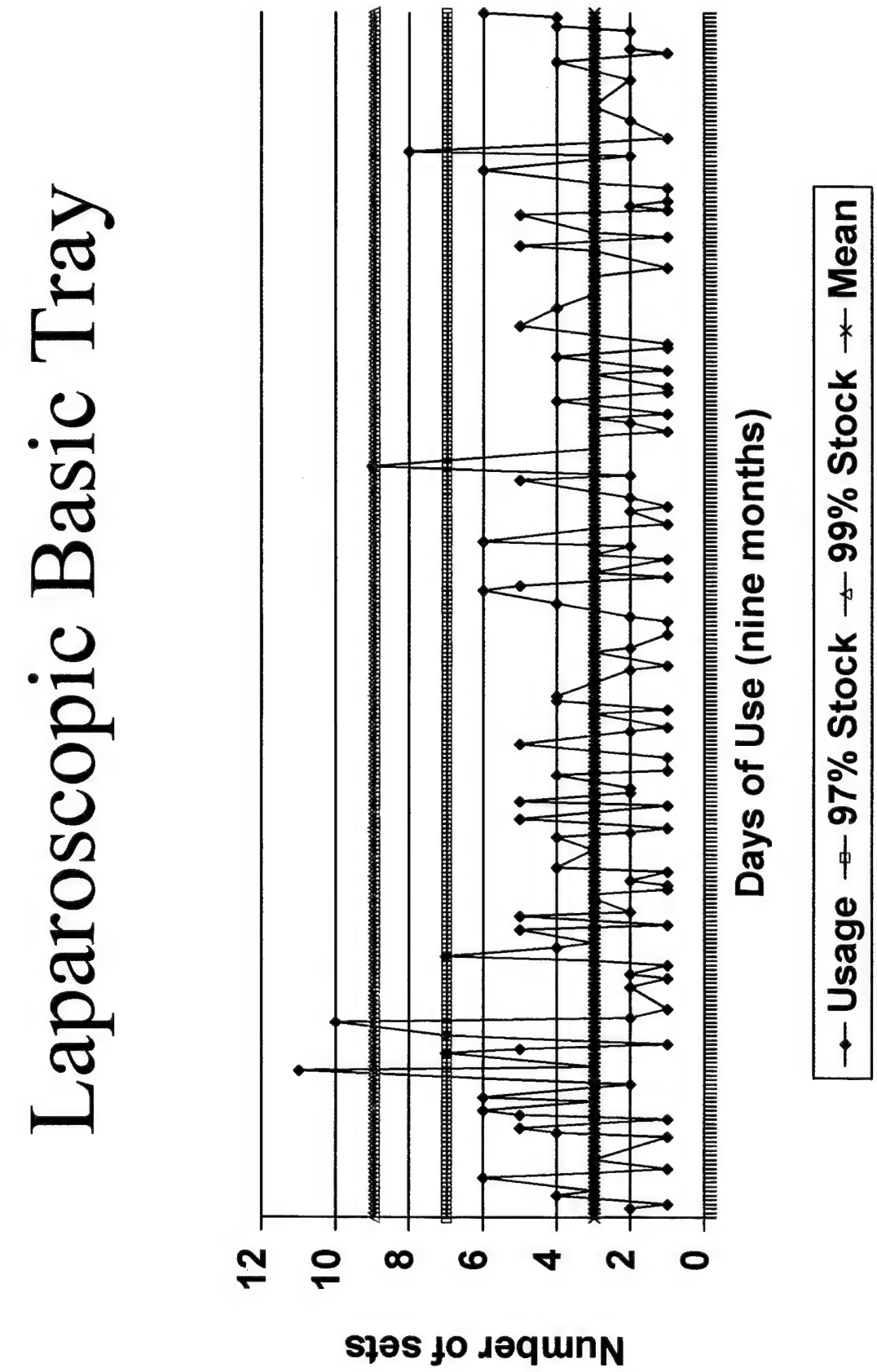


Bookwalter with Large Oval/Round ring

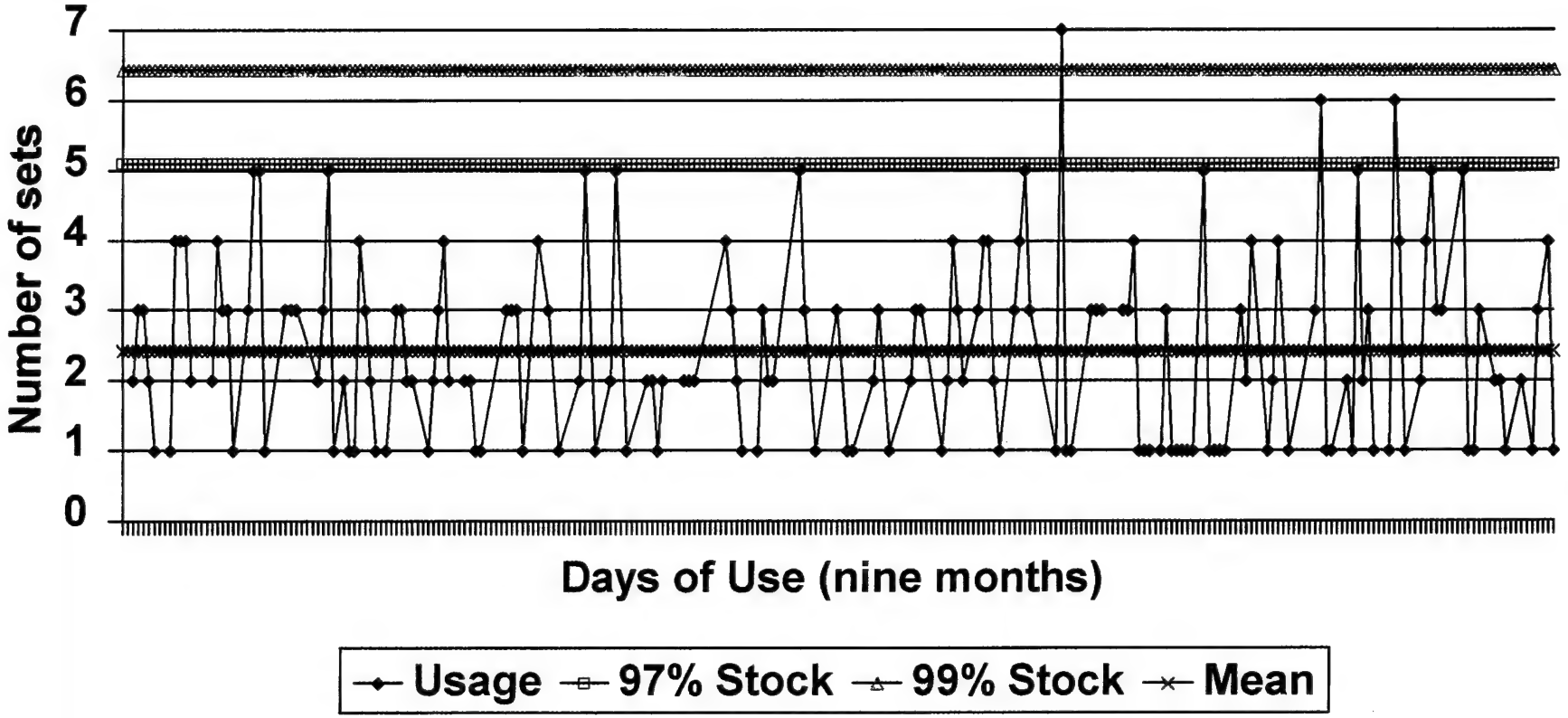


Mini Driver

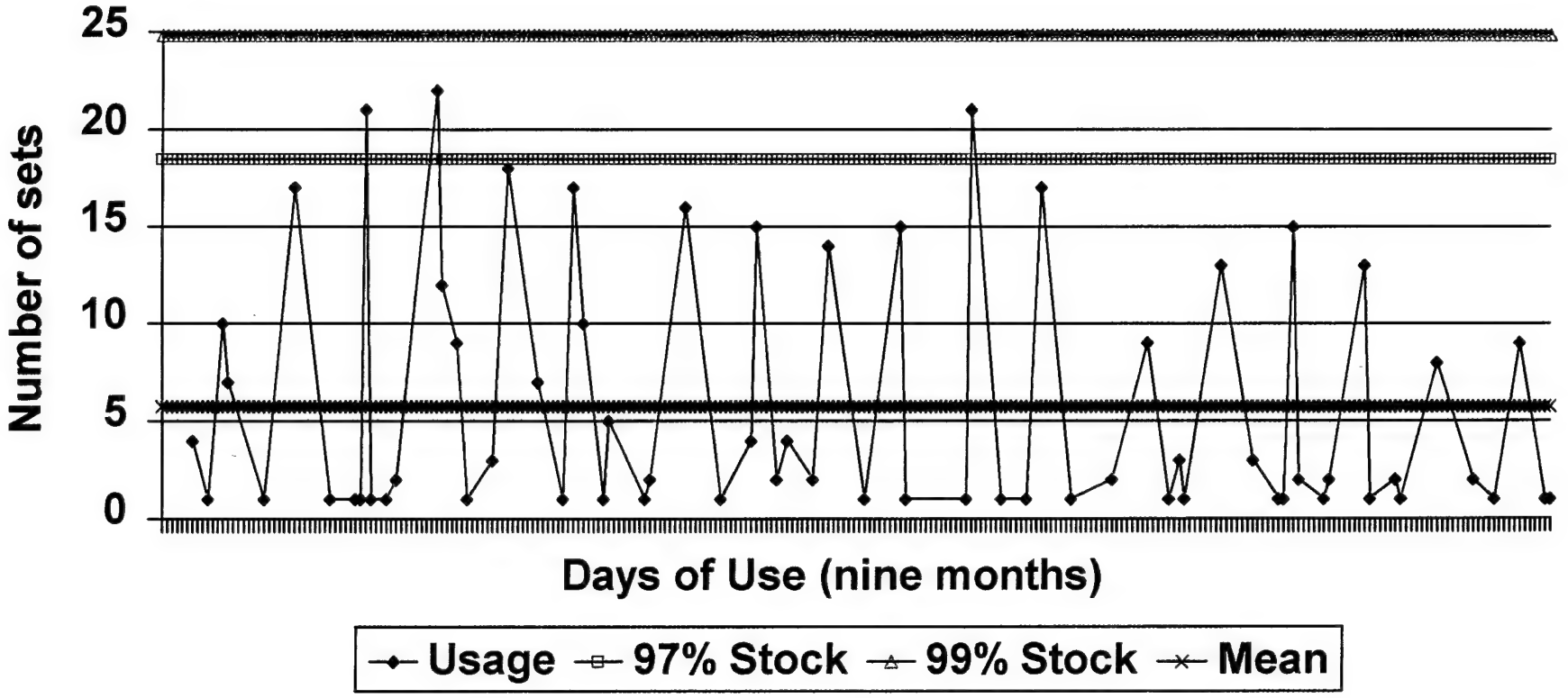

Number of sets
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean


Laparoscopic Basic Tray
Number of sets
12
10
8
6
4
2
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

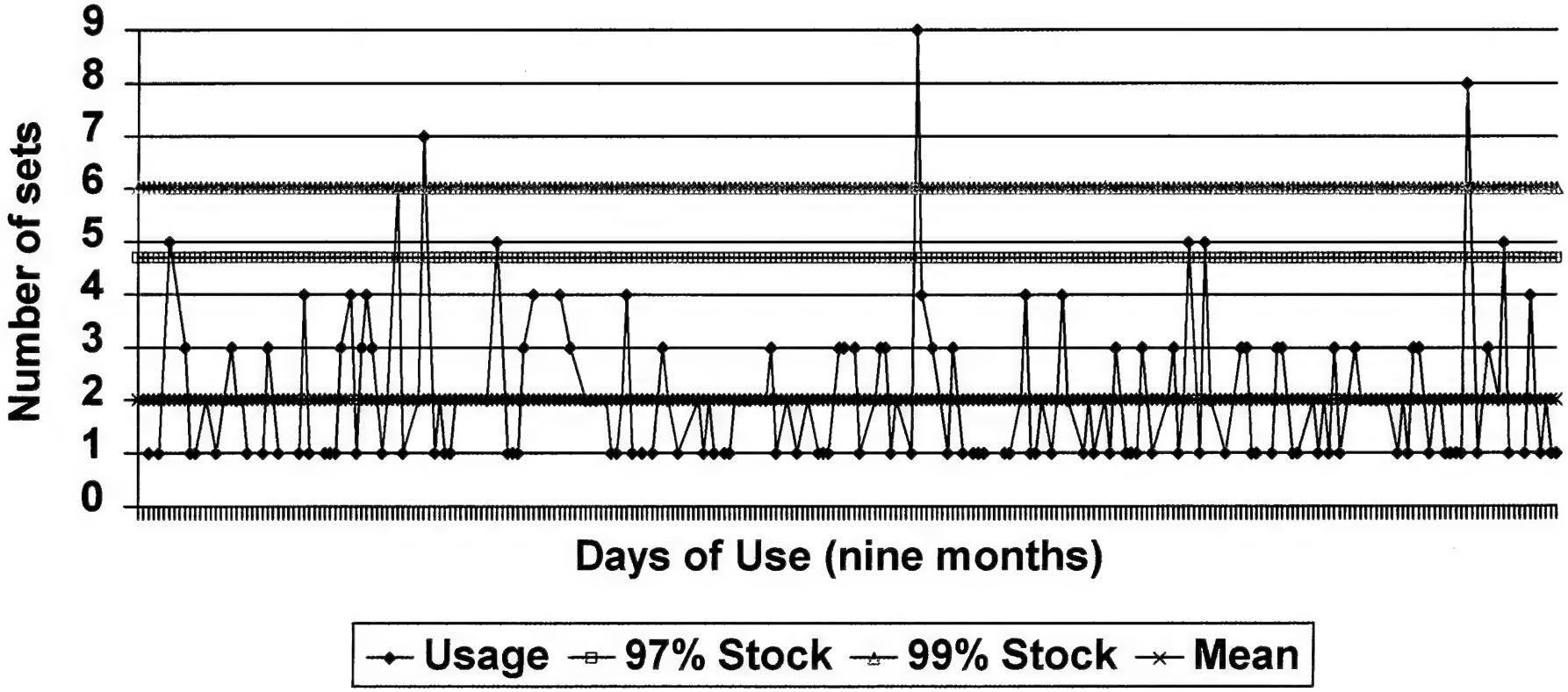
Ligaclip Applier, Long, Straight



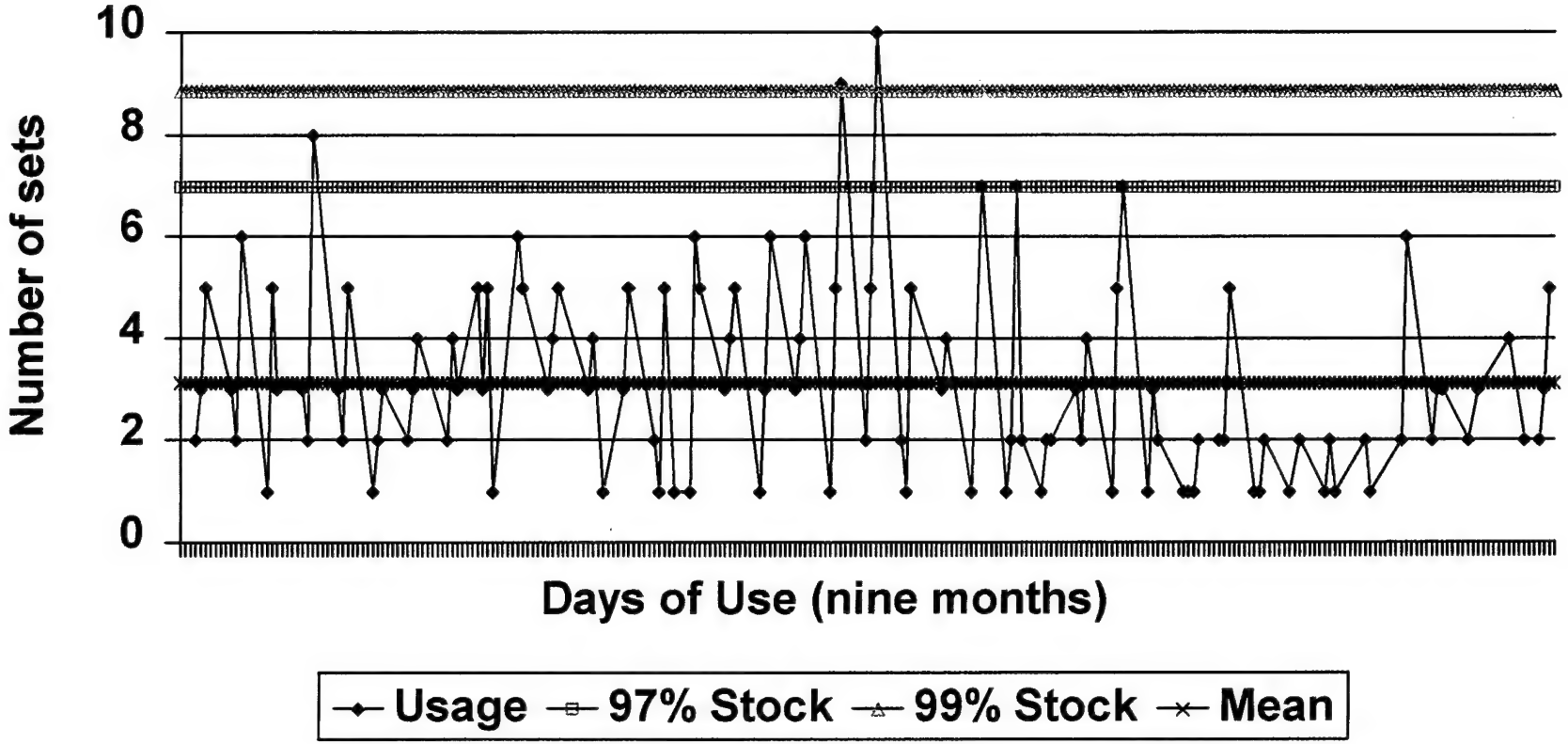
Myringotomy Set



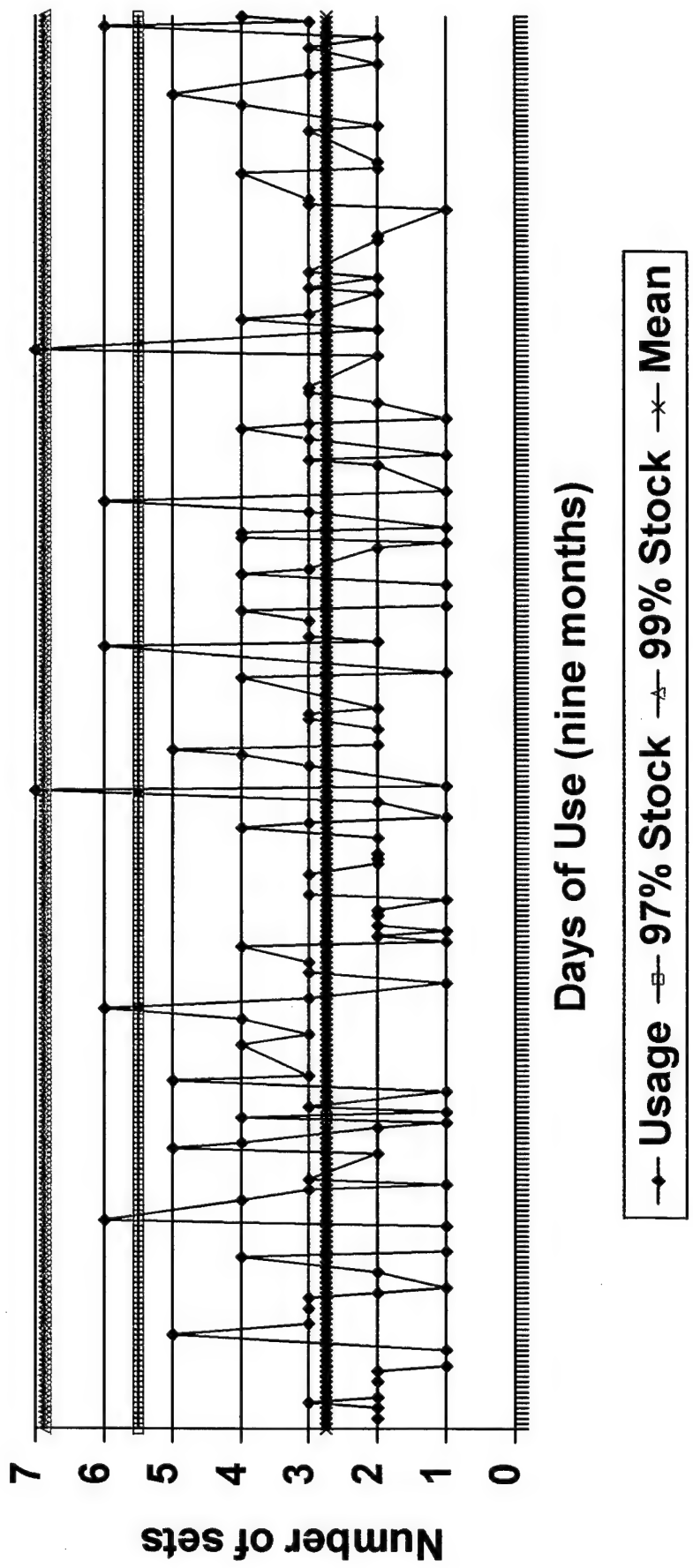
GI Specials


Number of sets
9
8
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

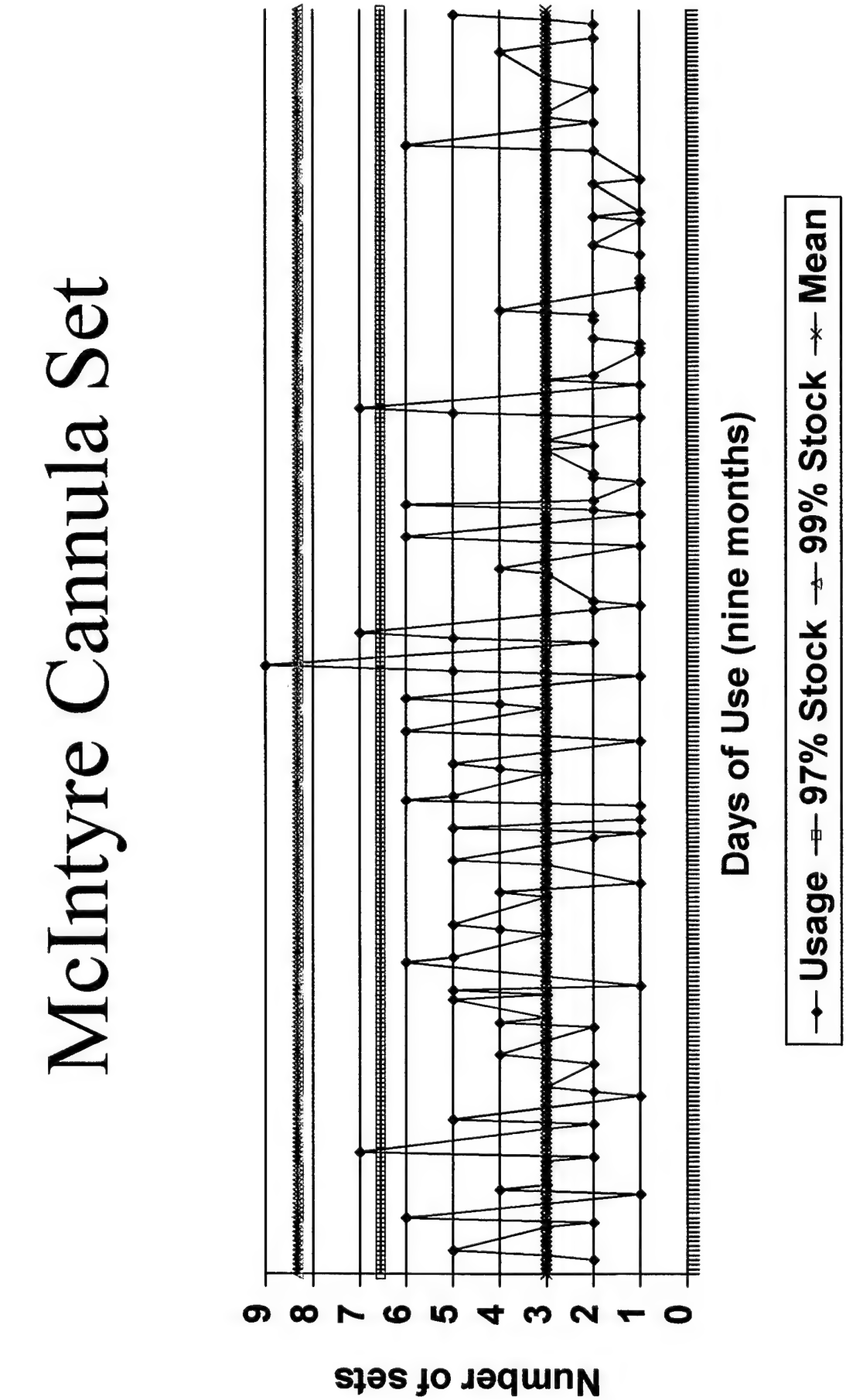
Eye Microscope (Wild) Handle Covers



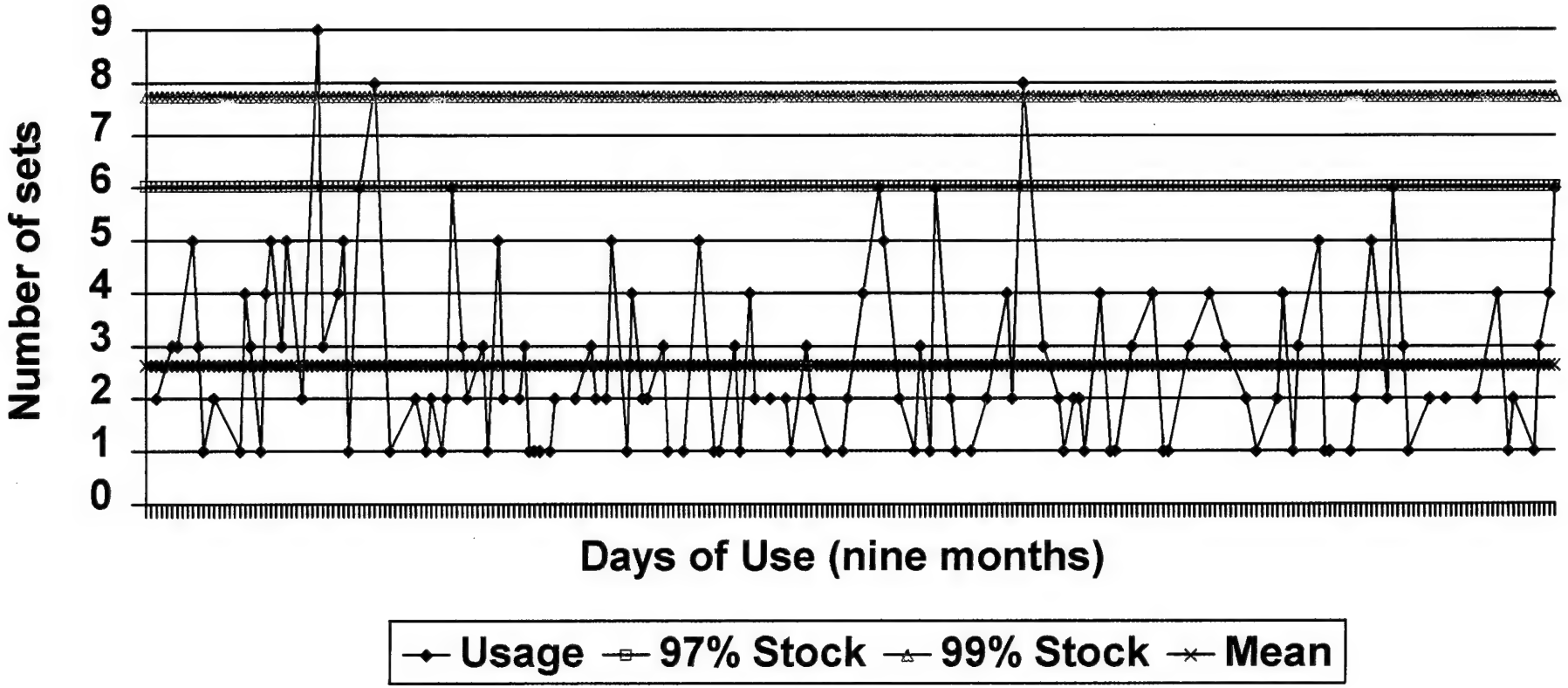
T & A Set


Number of sets
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

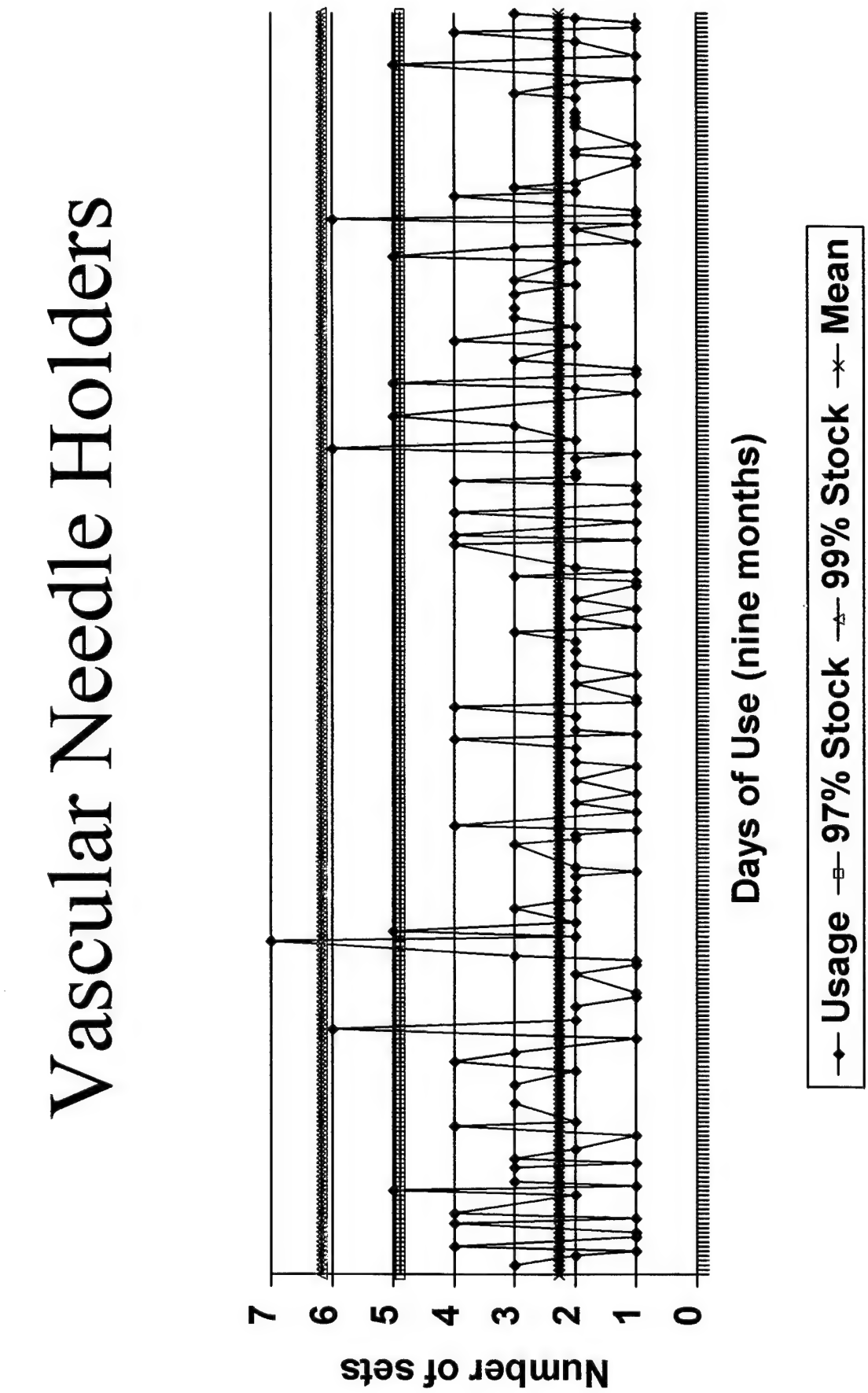
McIntyre Cannula Set



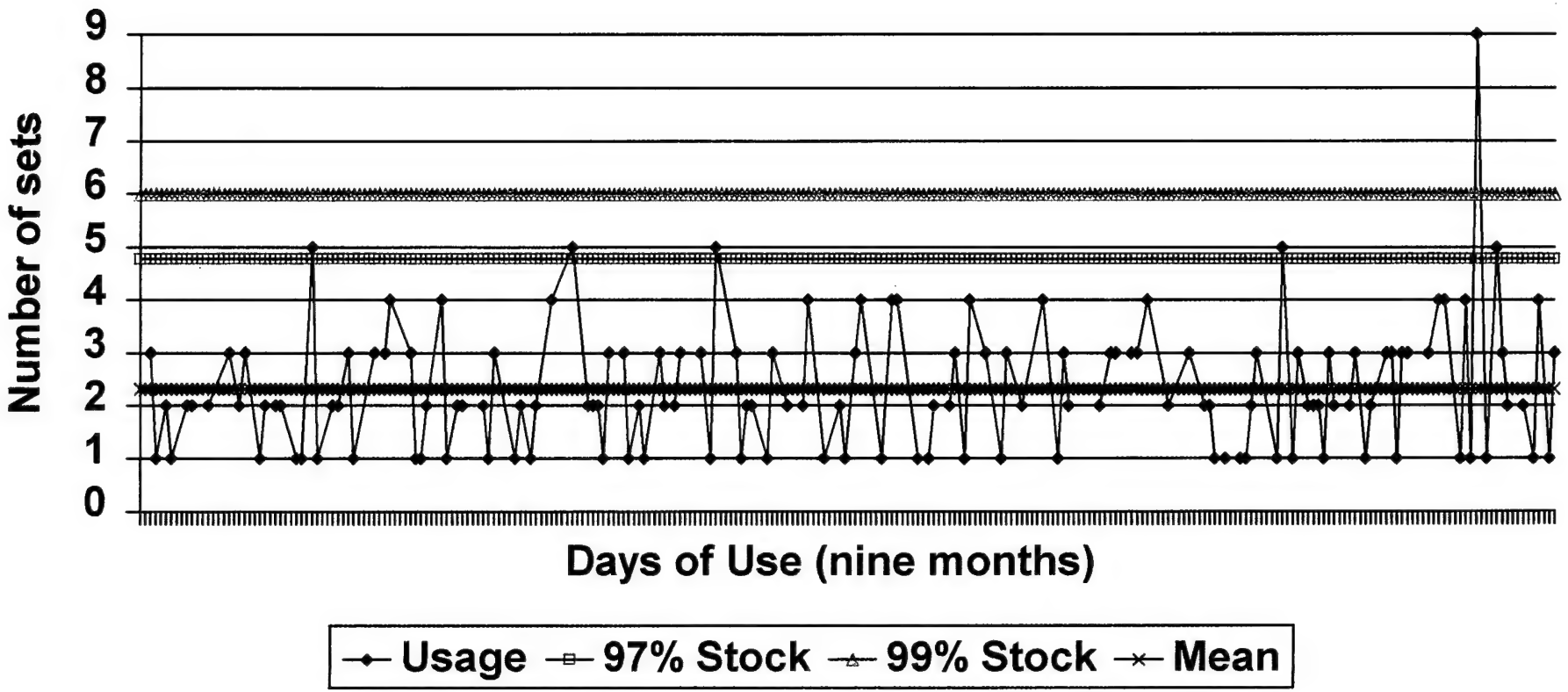
Laparoscope Any Diag. 10mm/0 Degrees



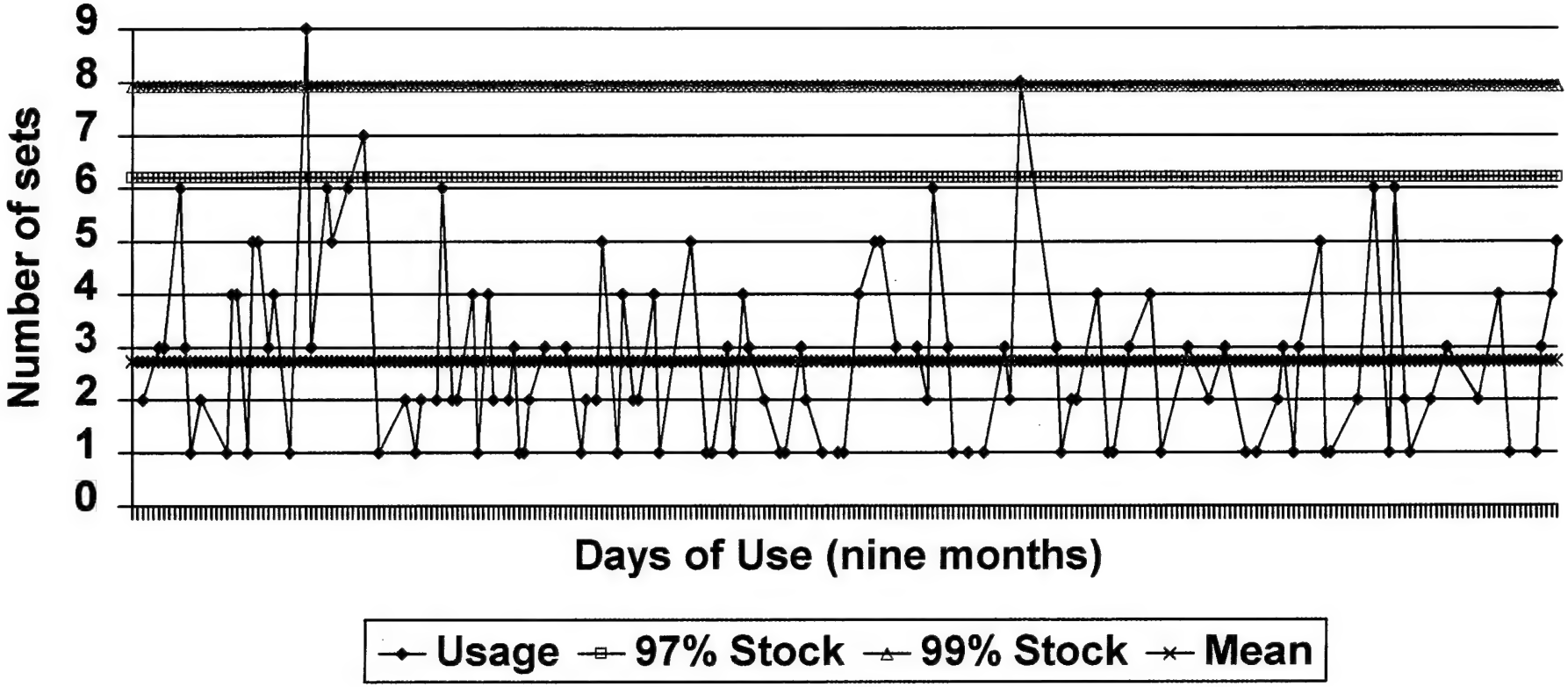
Vascular Needle Holders



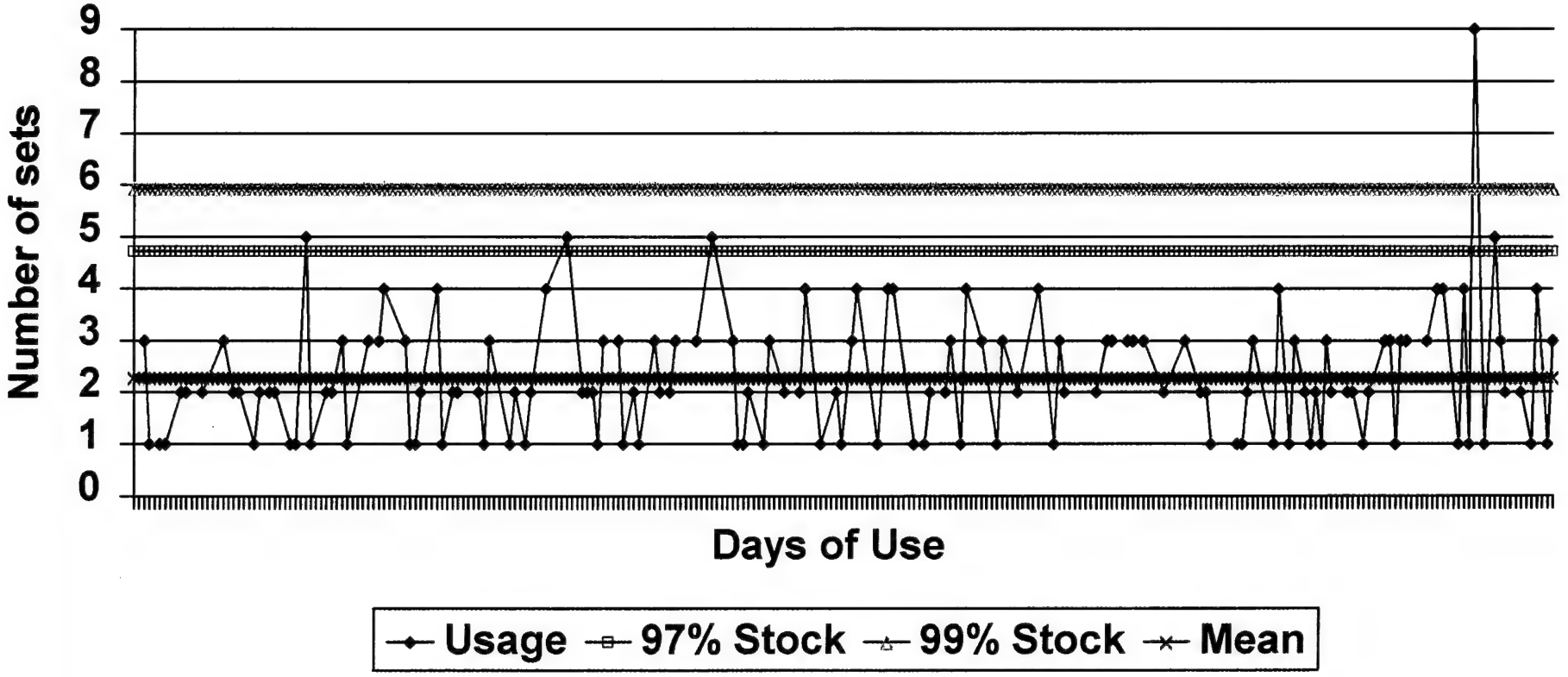
Concept Intra-arc Shaver System



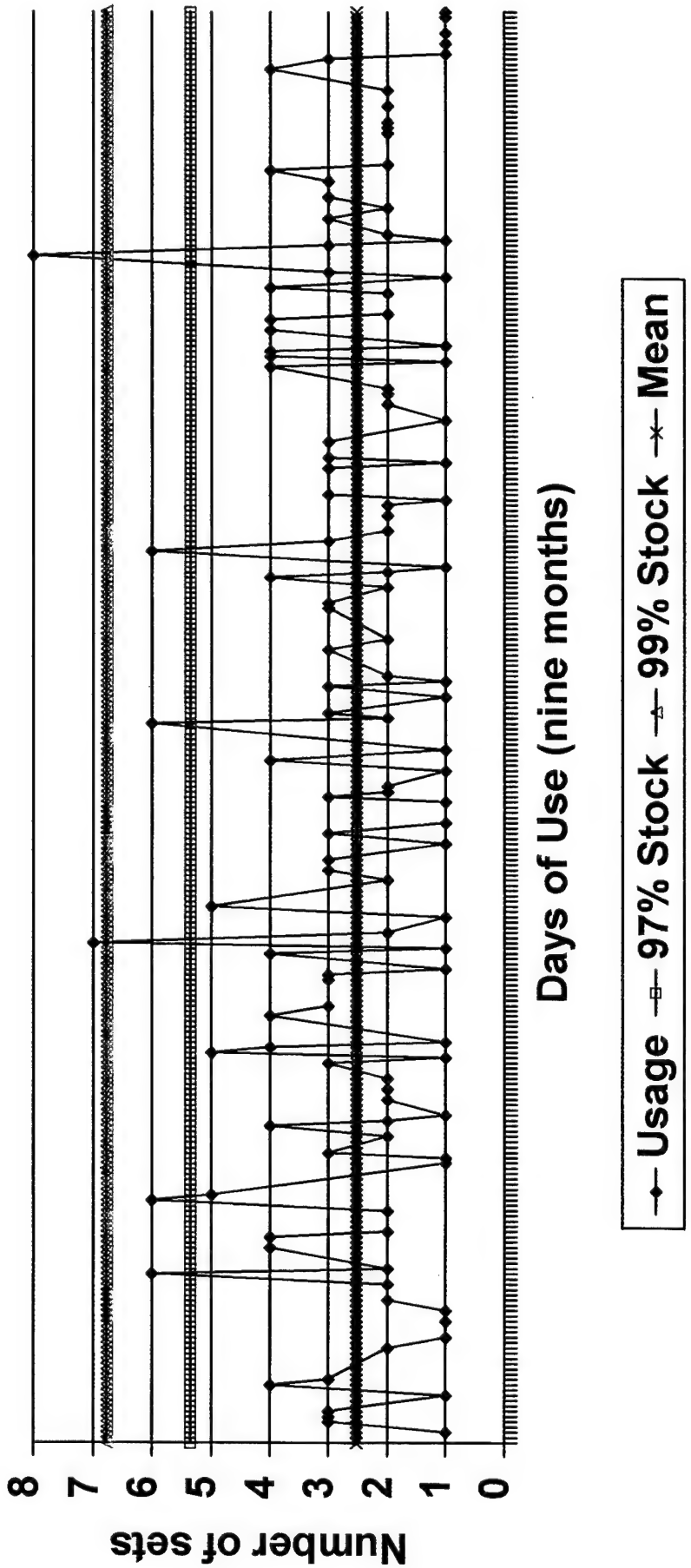
Hasson Instruments



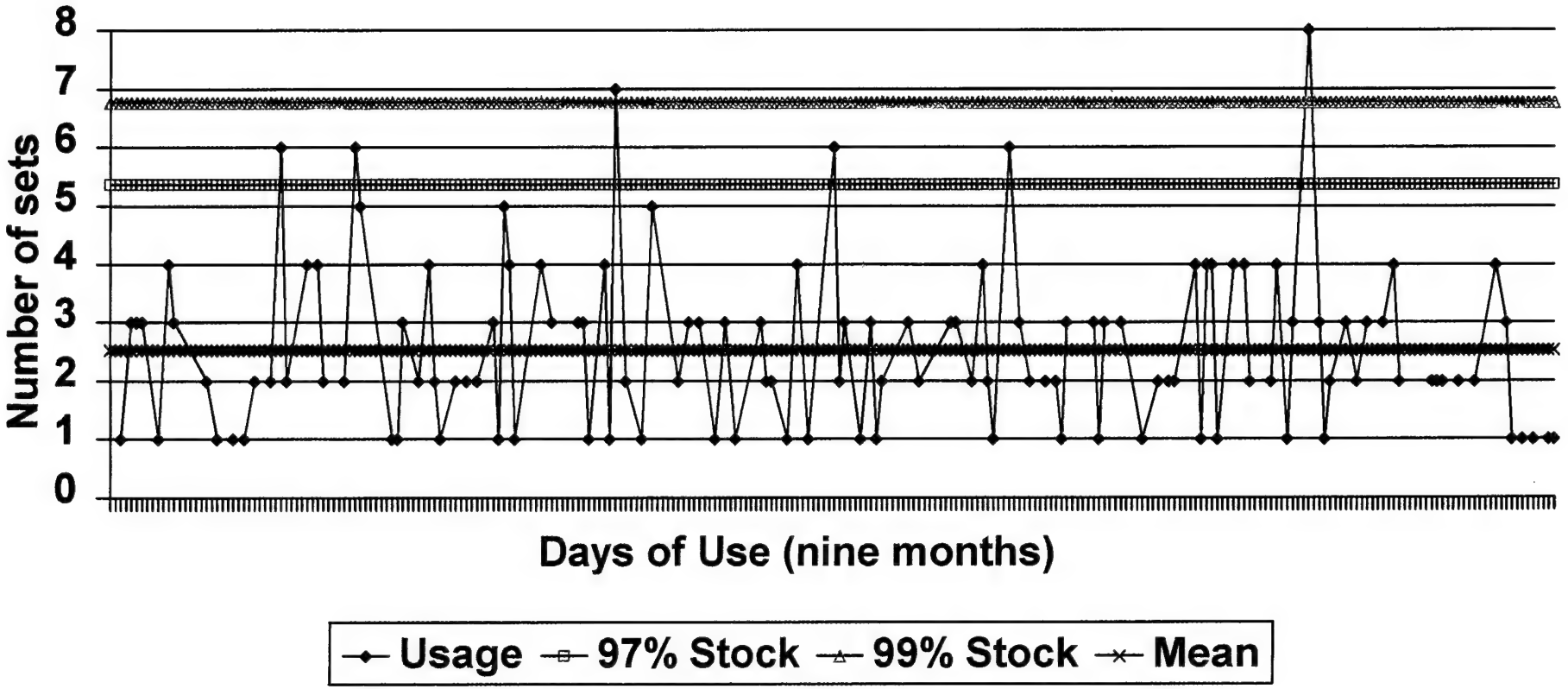
Arthroscope, Wolf, 4mm/25 Deg.



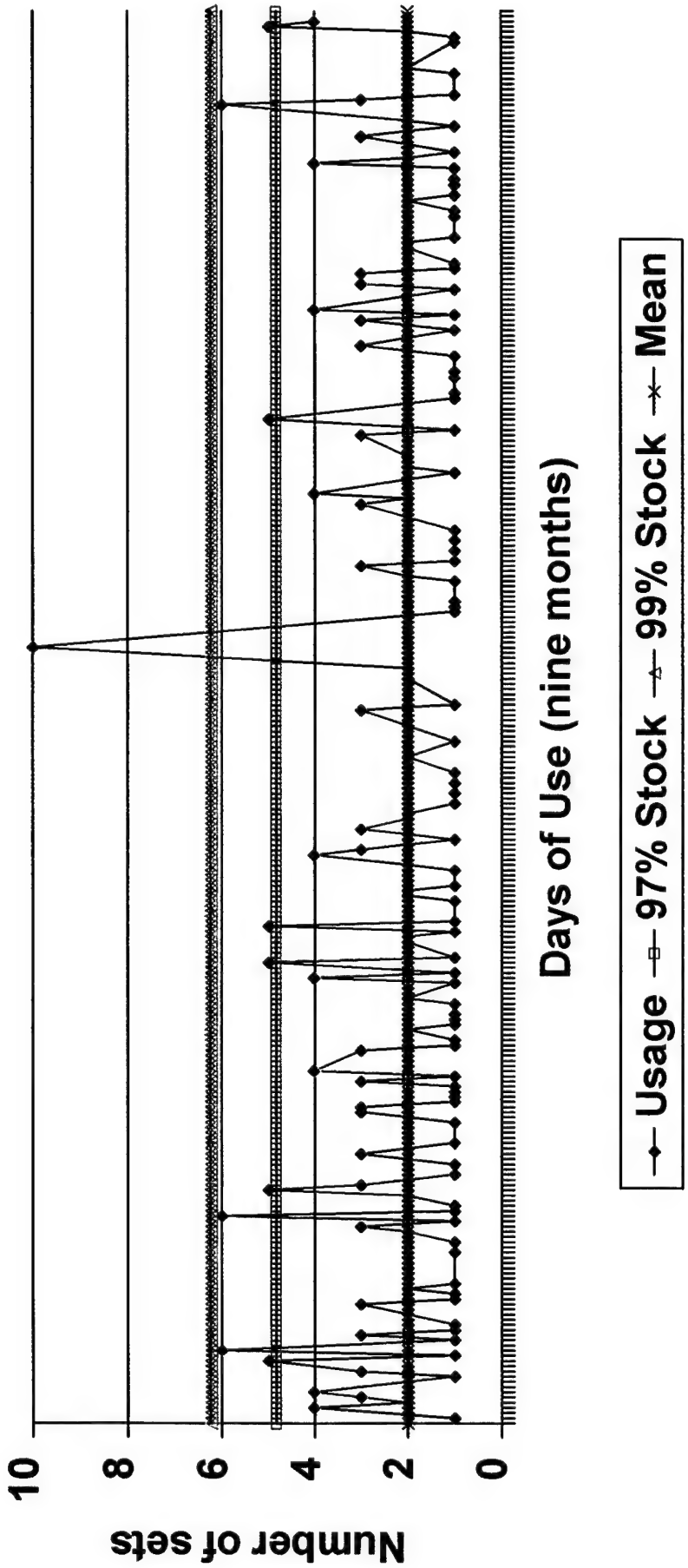
Nasal Prep Set



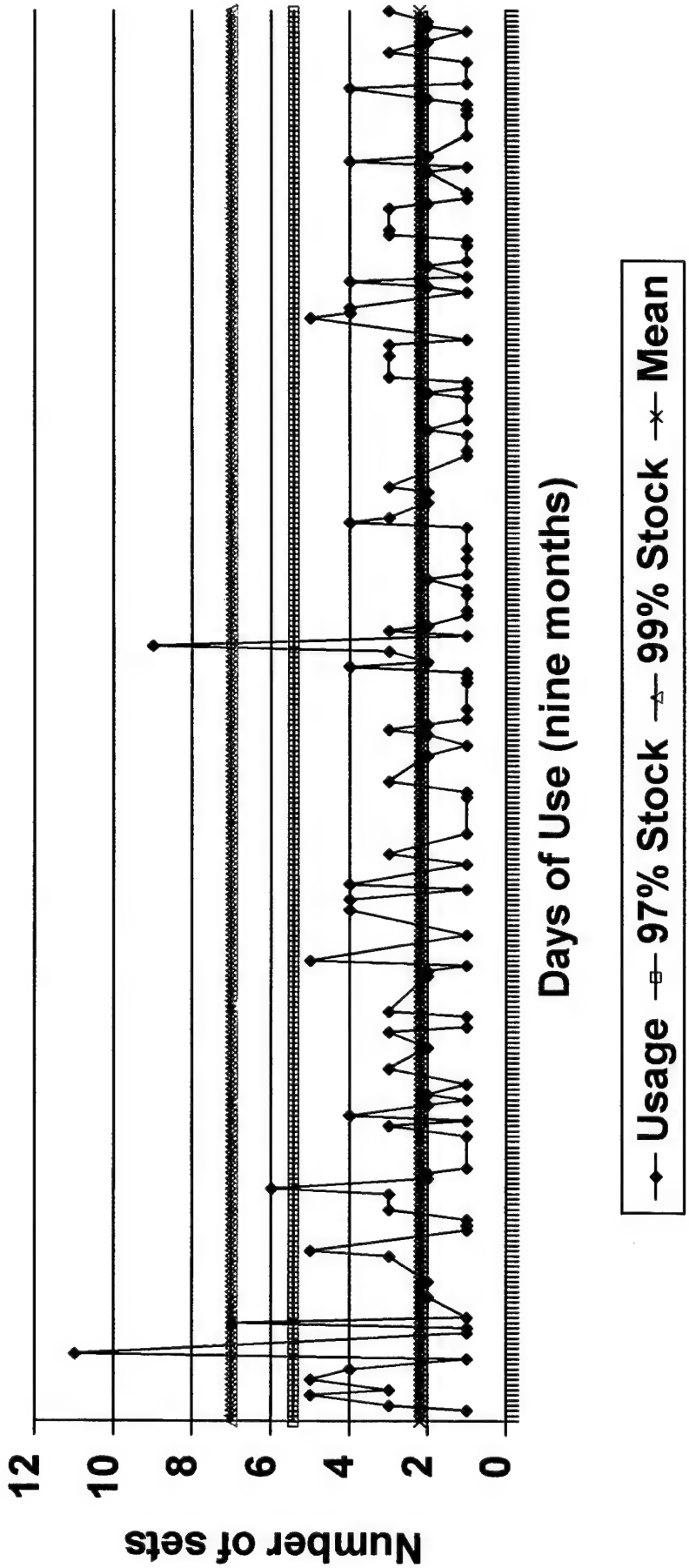
ENT Septo-Rhinoplasty Set

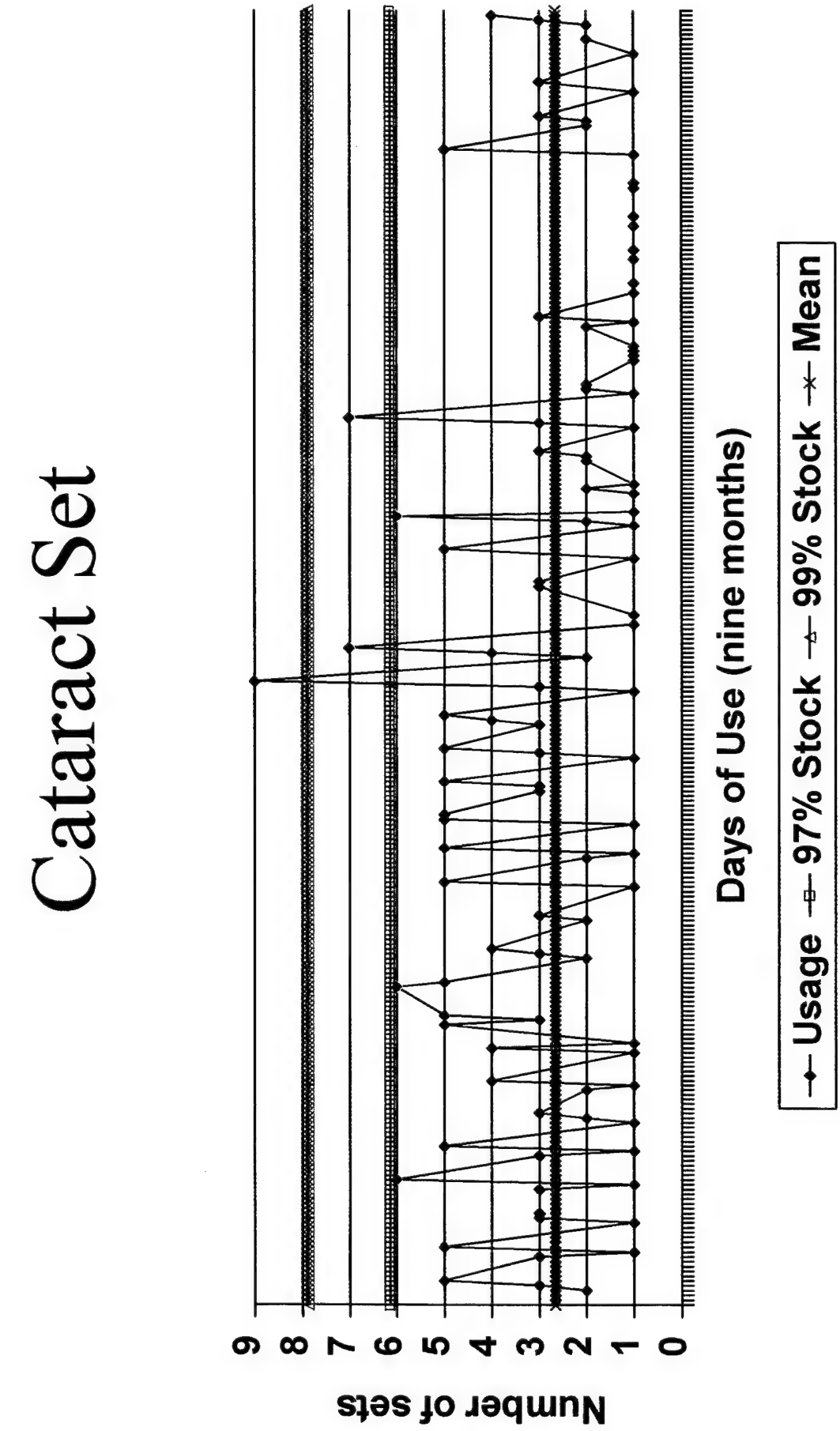


Delicate Extras

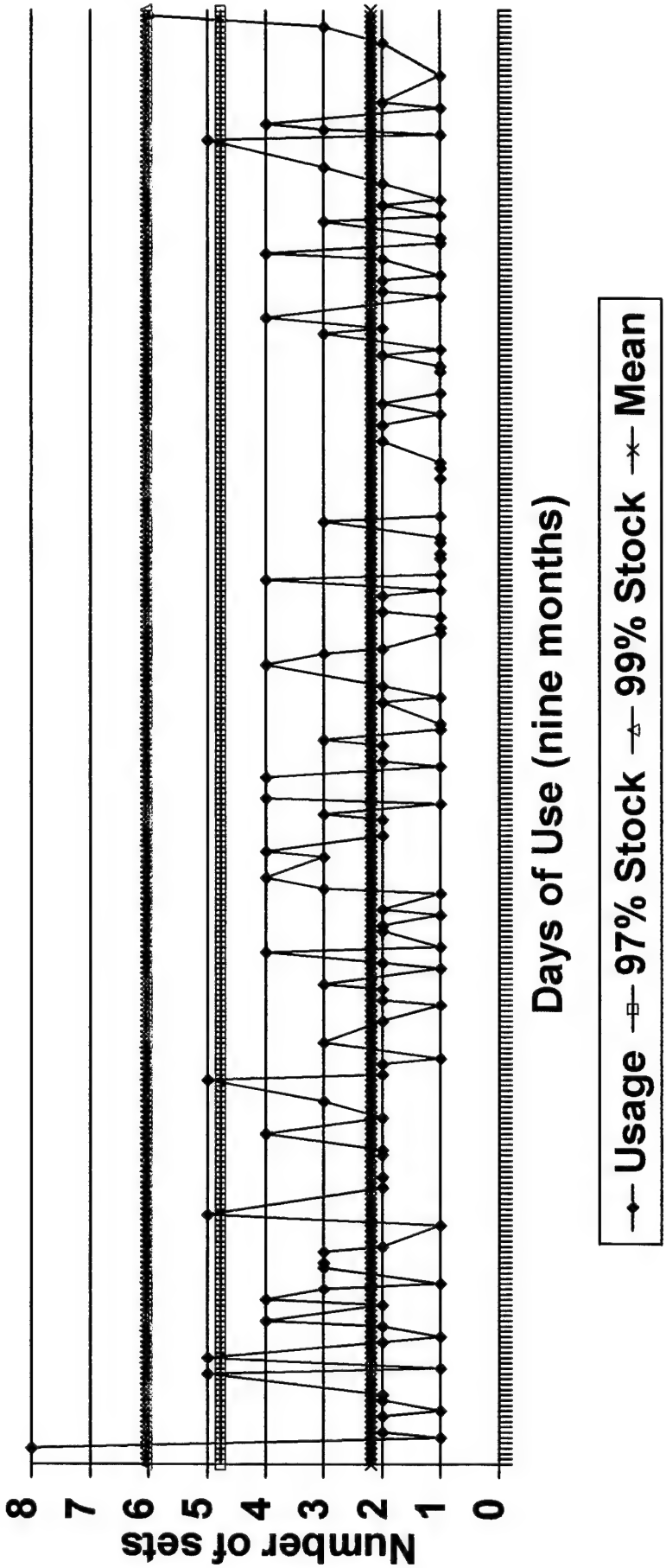


D & C Set

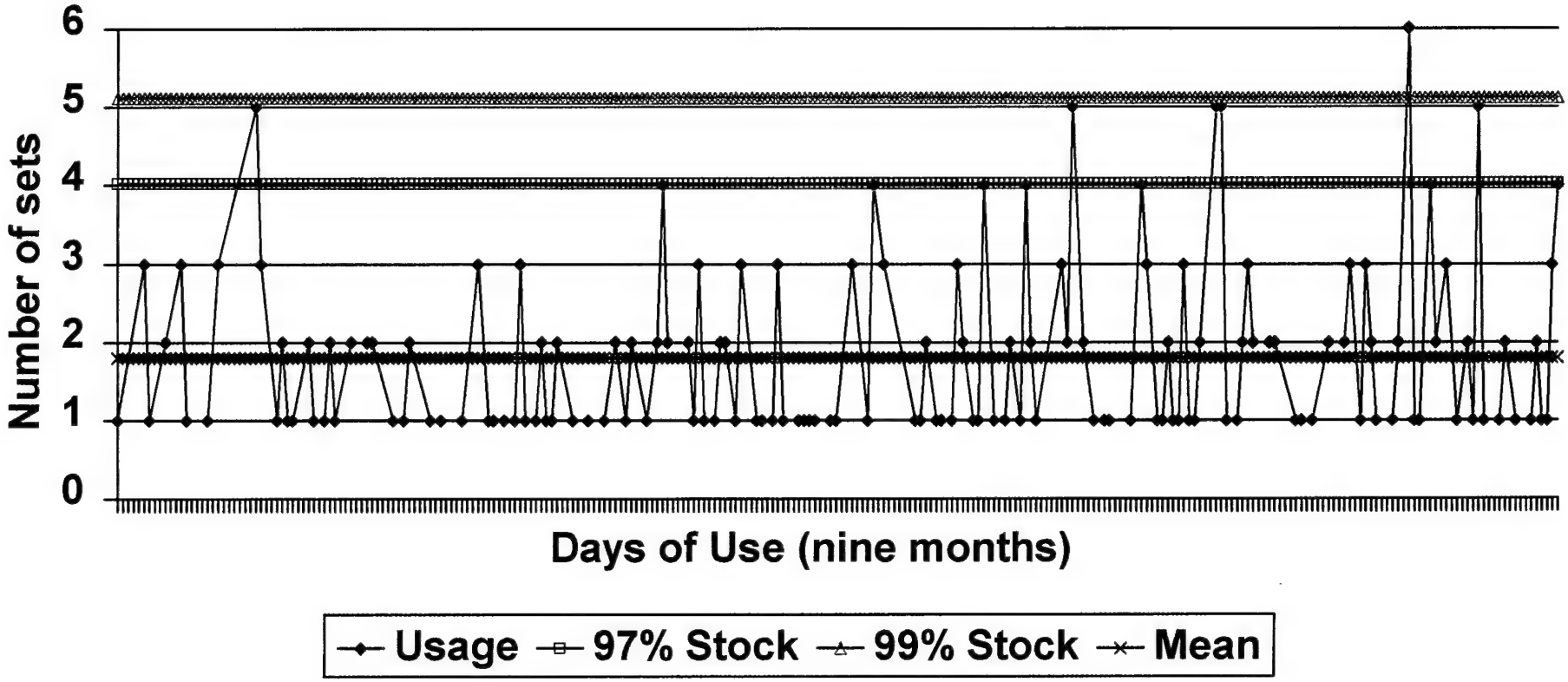

Number of sets
12
10
8
6
4
2
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean


Cataract Set
Number of sets
9
8
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

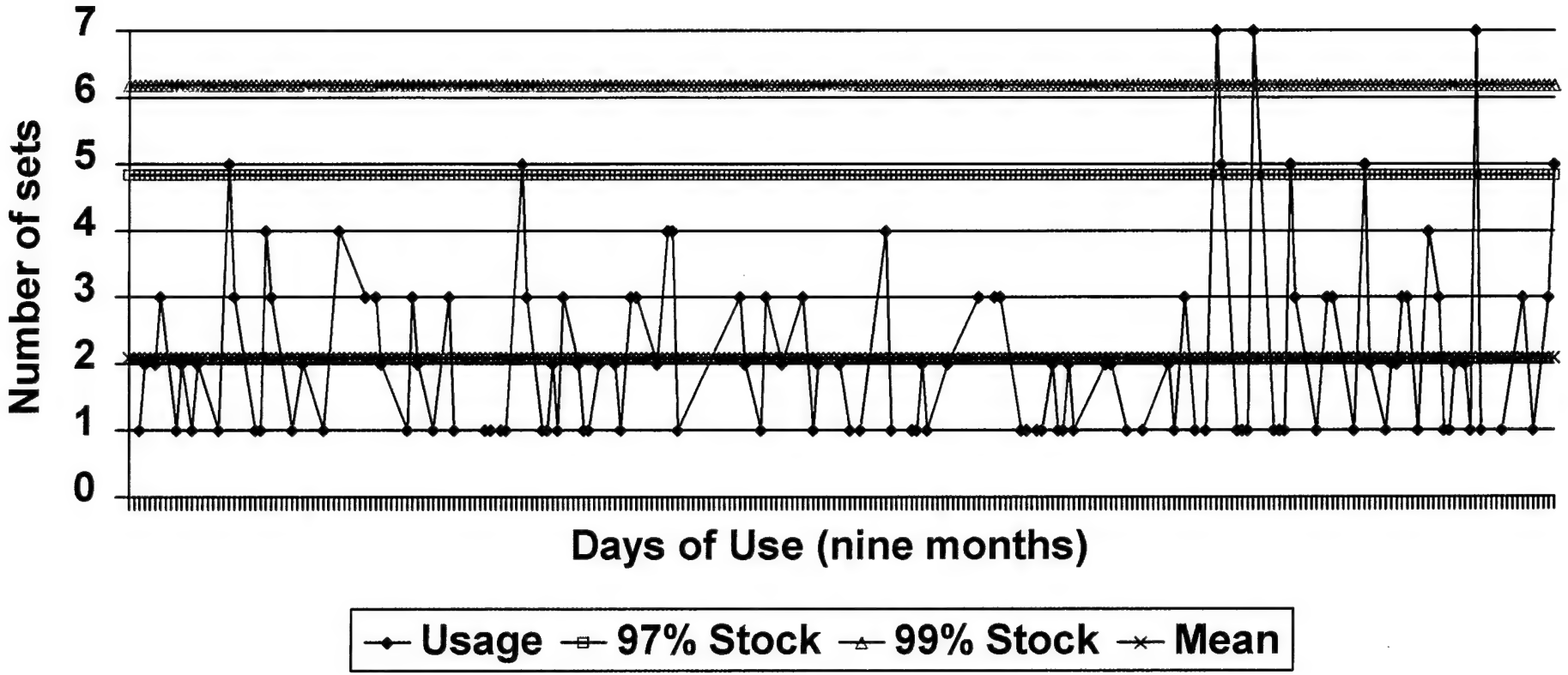
GYN Specials Set

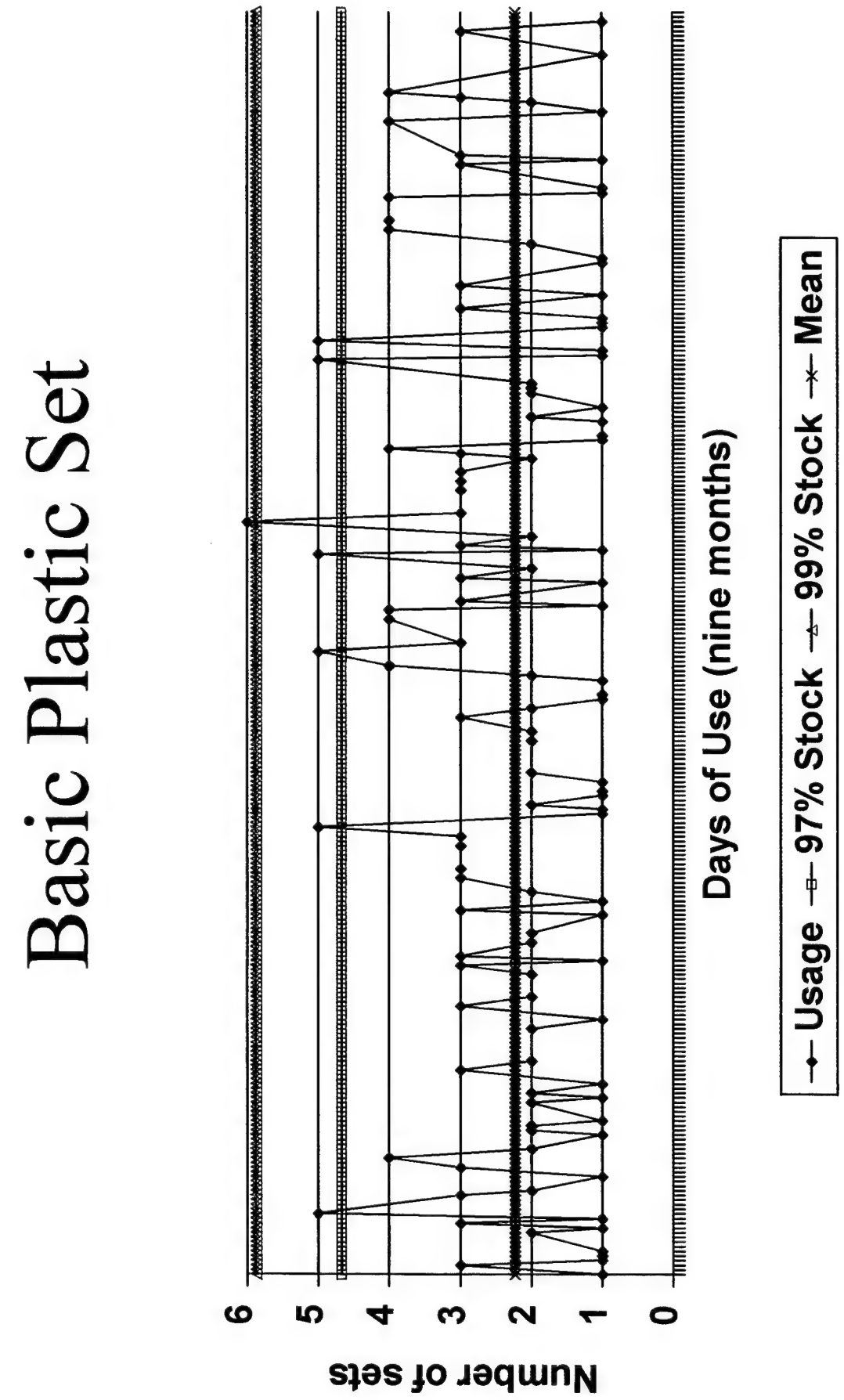


Steinman Pin Set Smooth

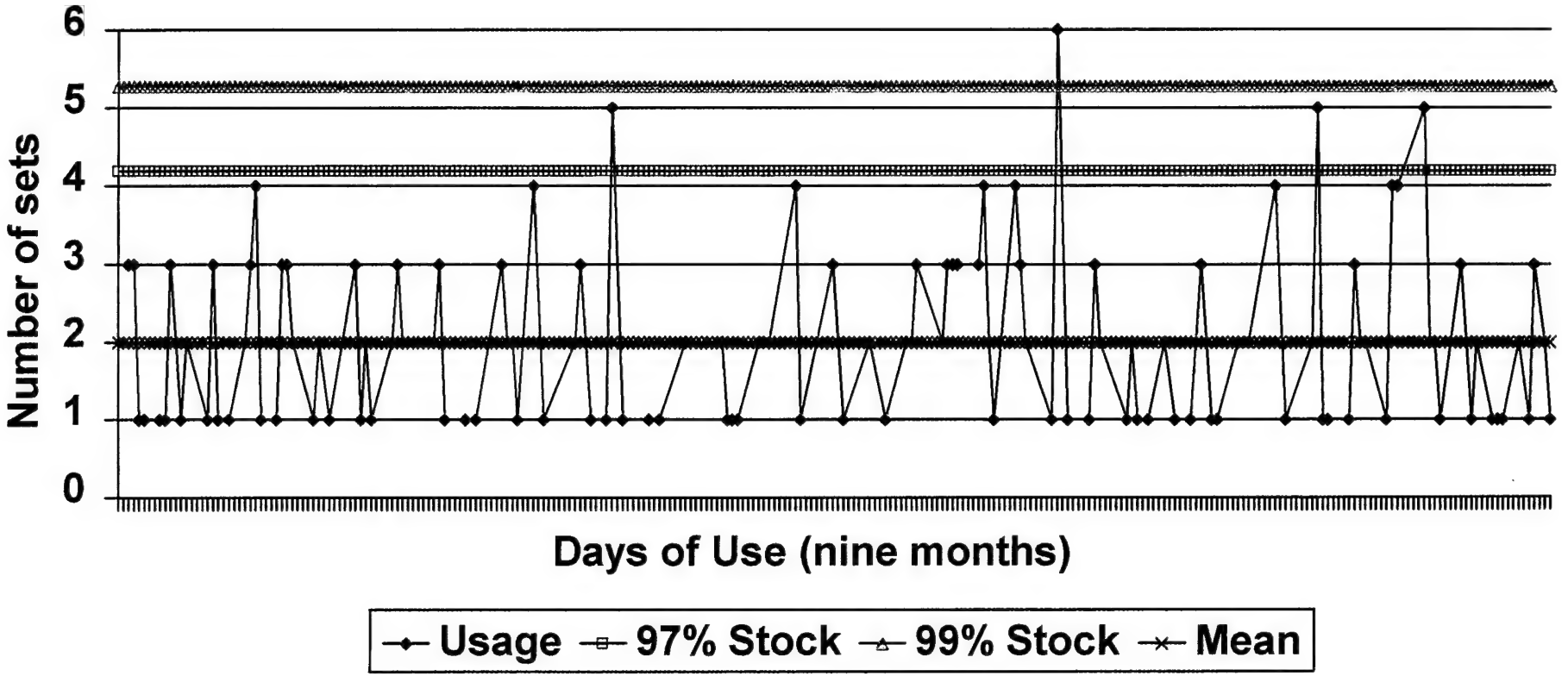


Micro Aire Drill

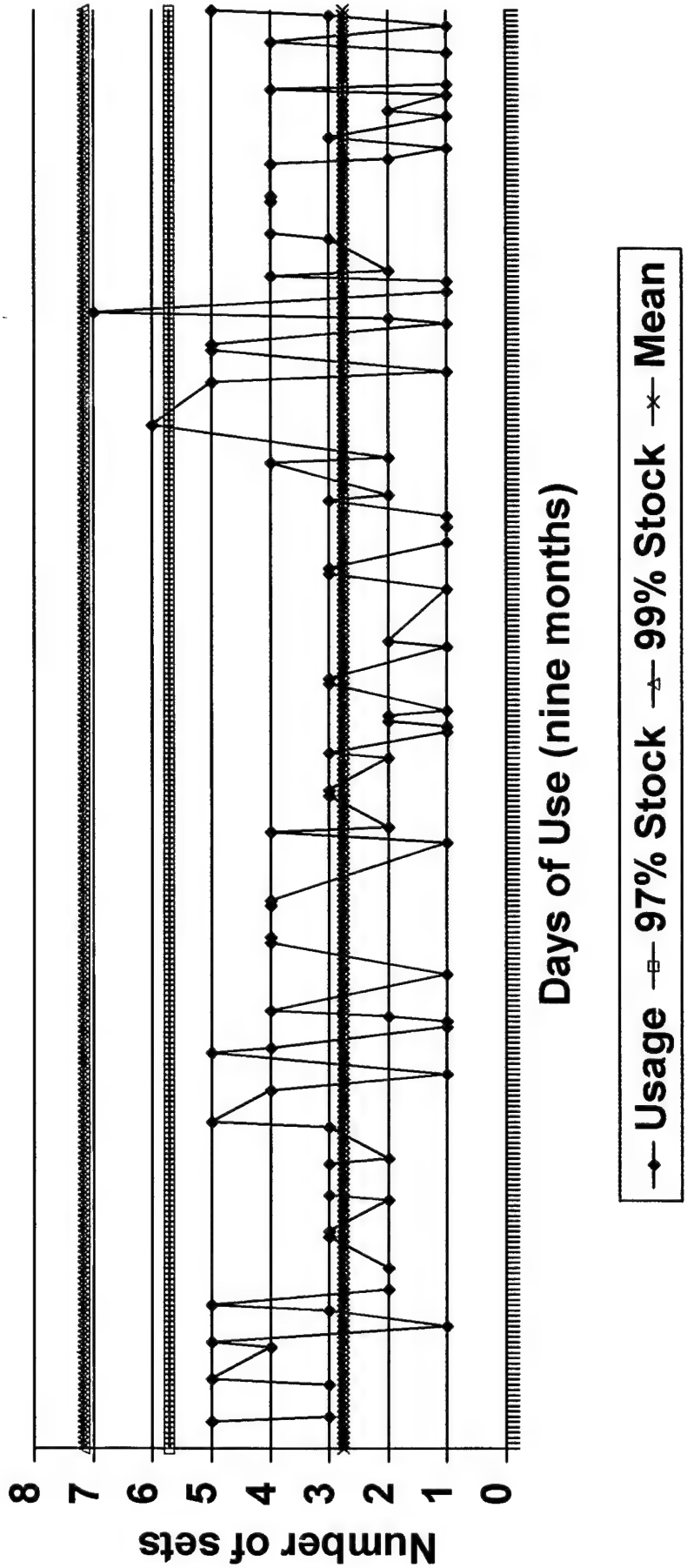



Basic Plastic Set
Number of sets
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

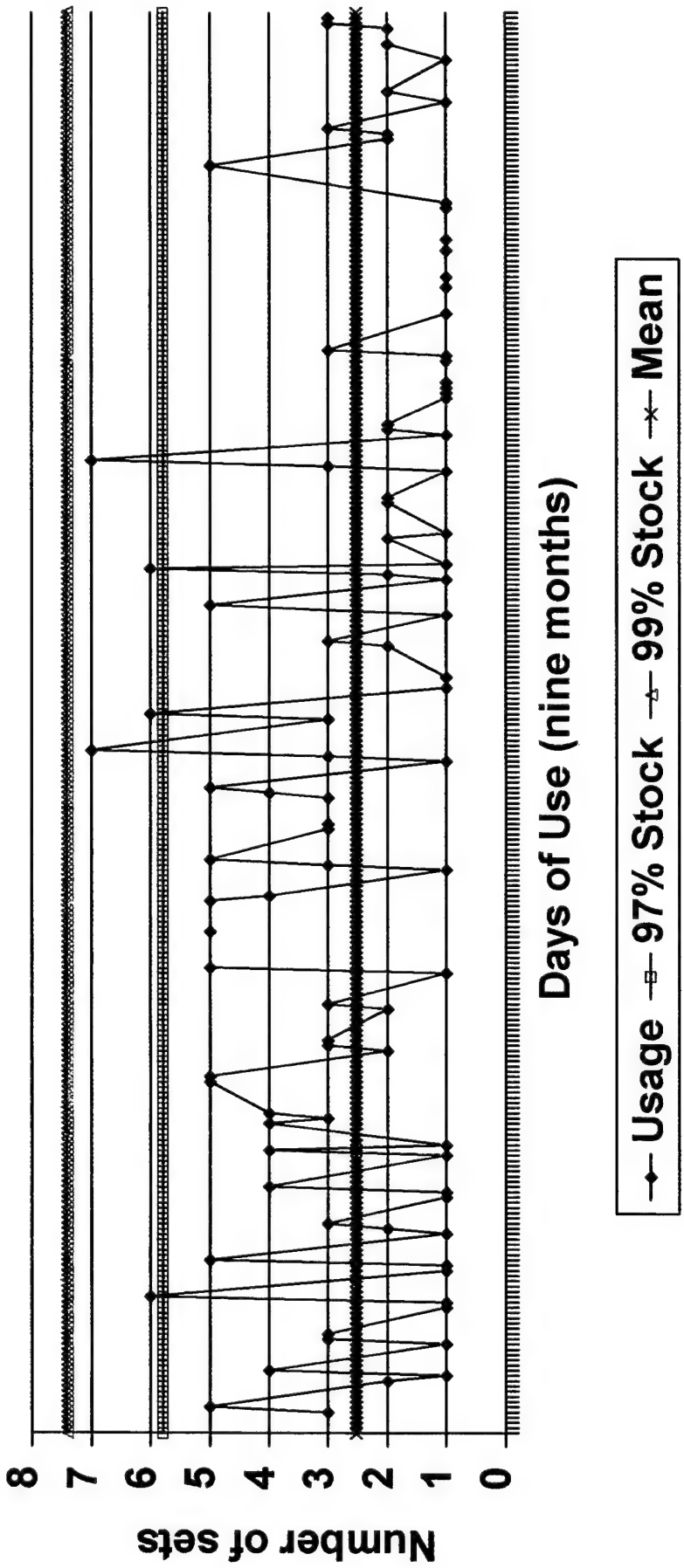
Ligaclip Applier, Long Angled

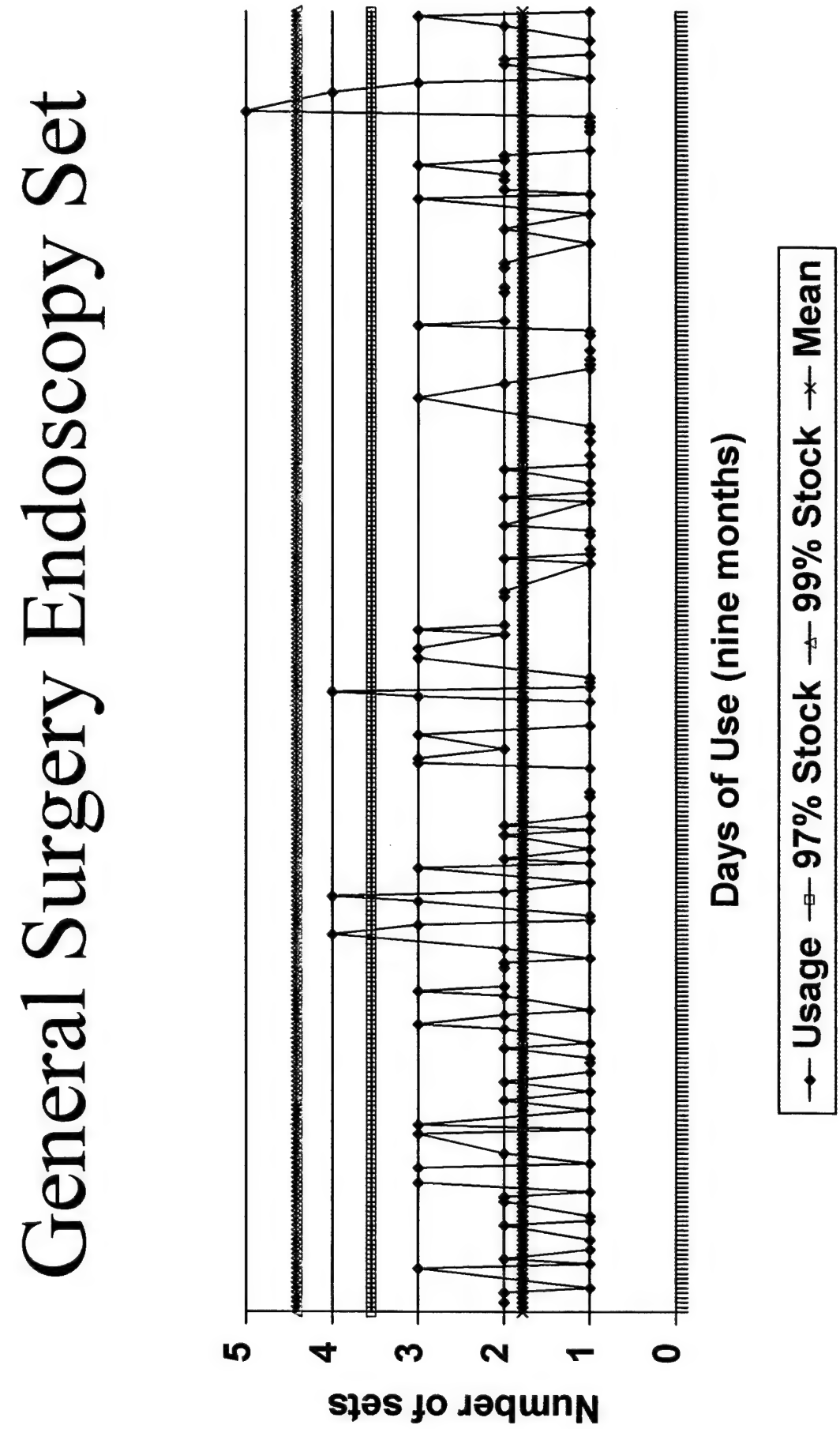


Bunion Set

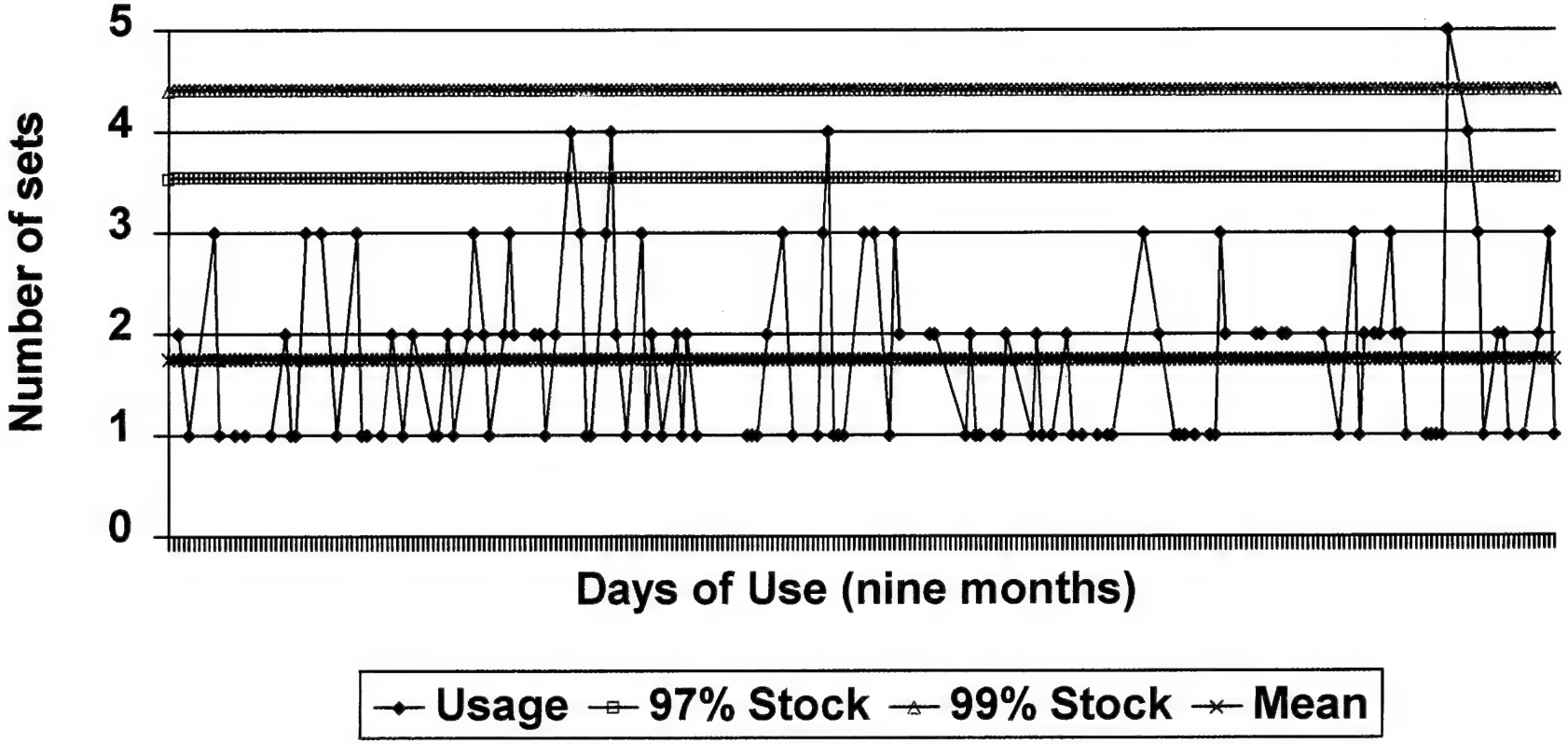

Number of sets
8
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Phaco Instrument

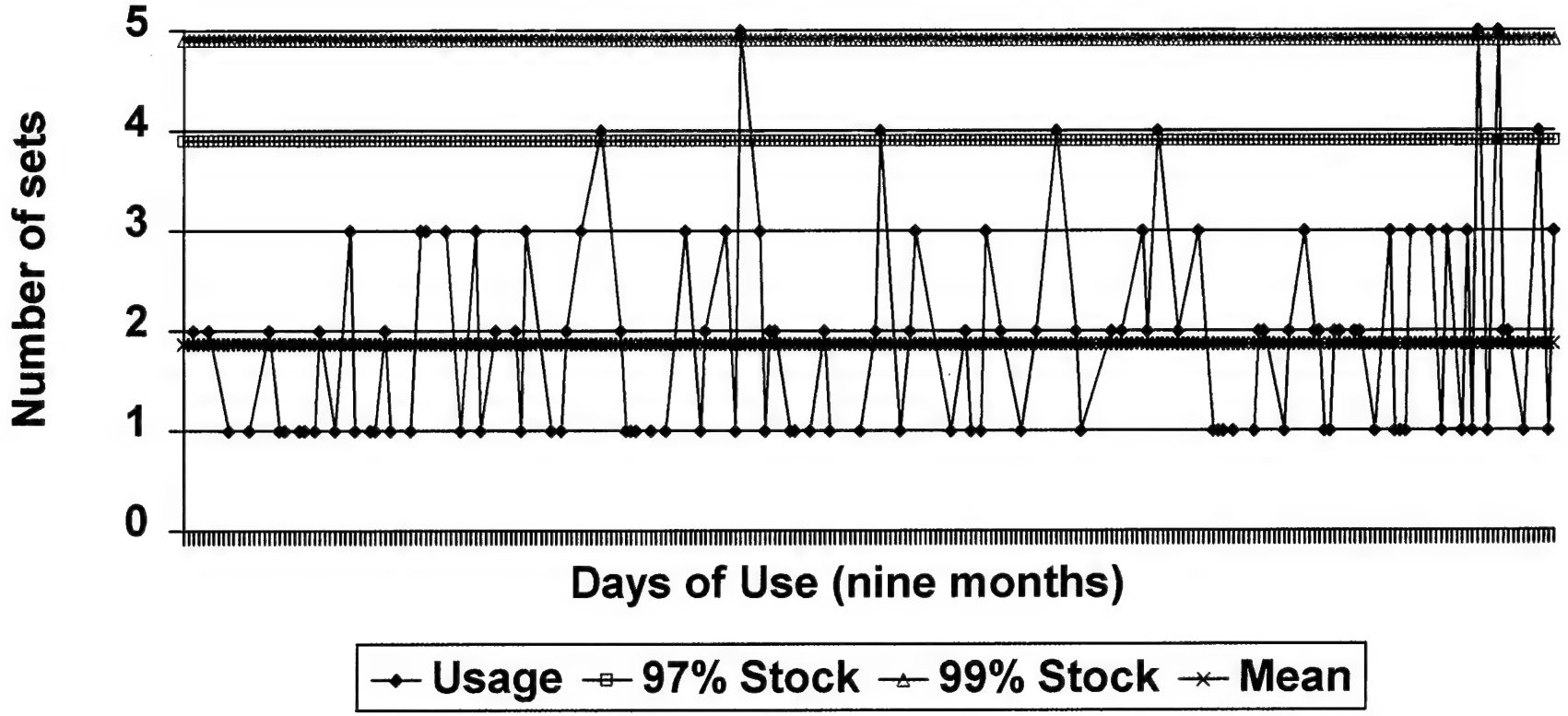


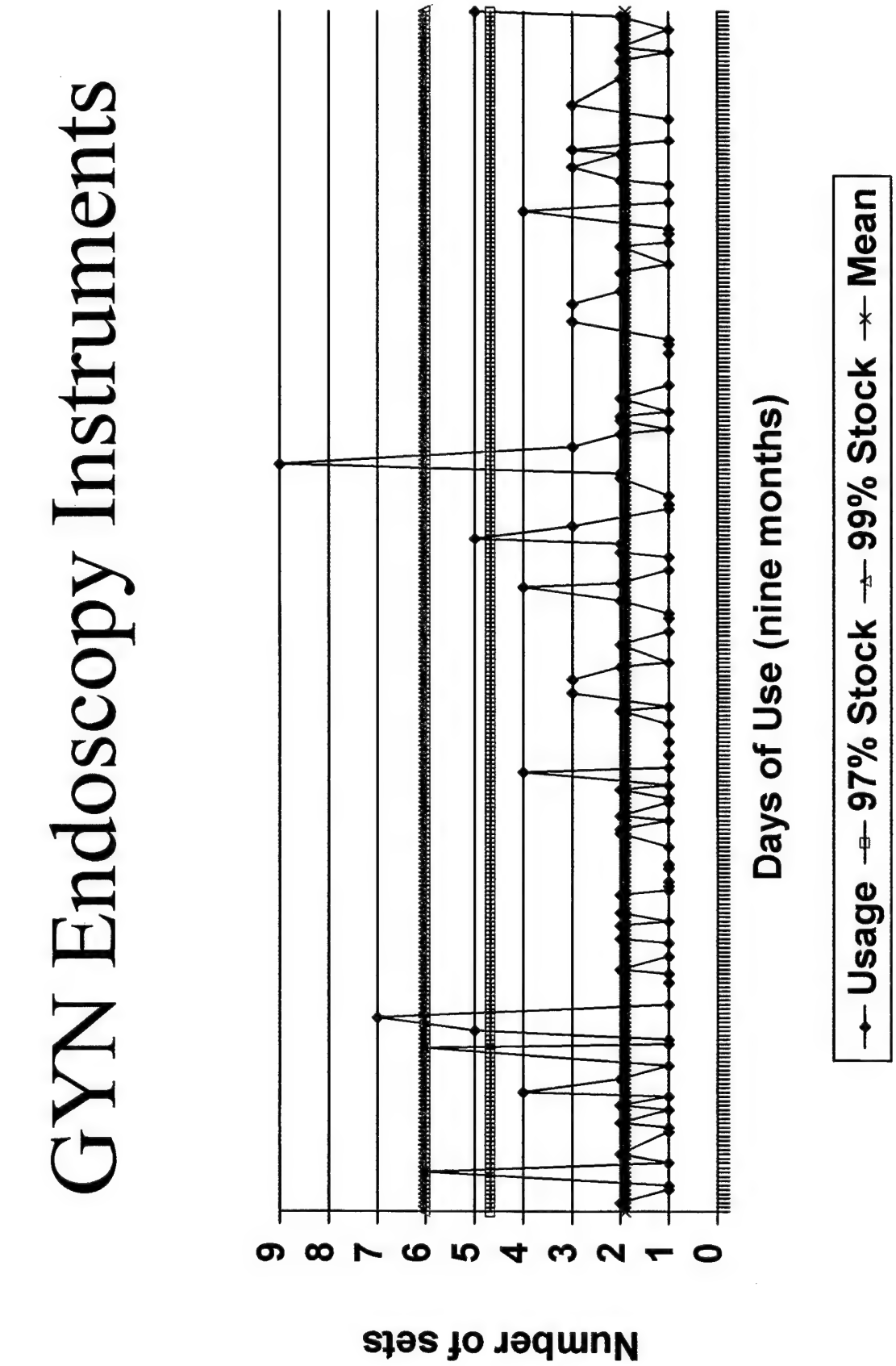

General Surgery Endoscopy Set
Number of sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

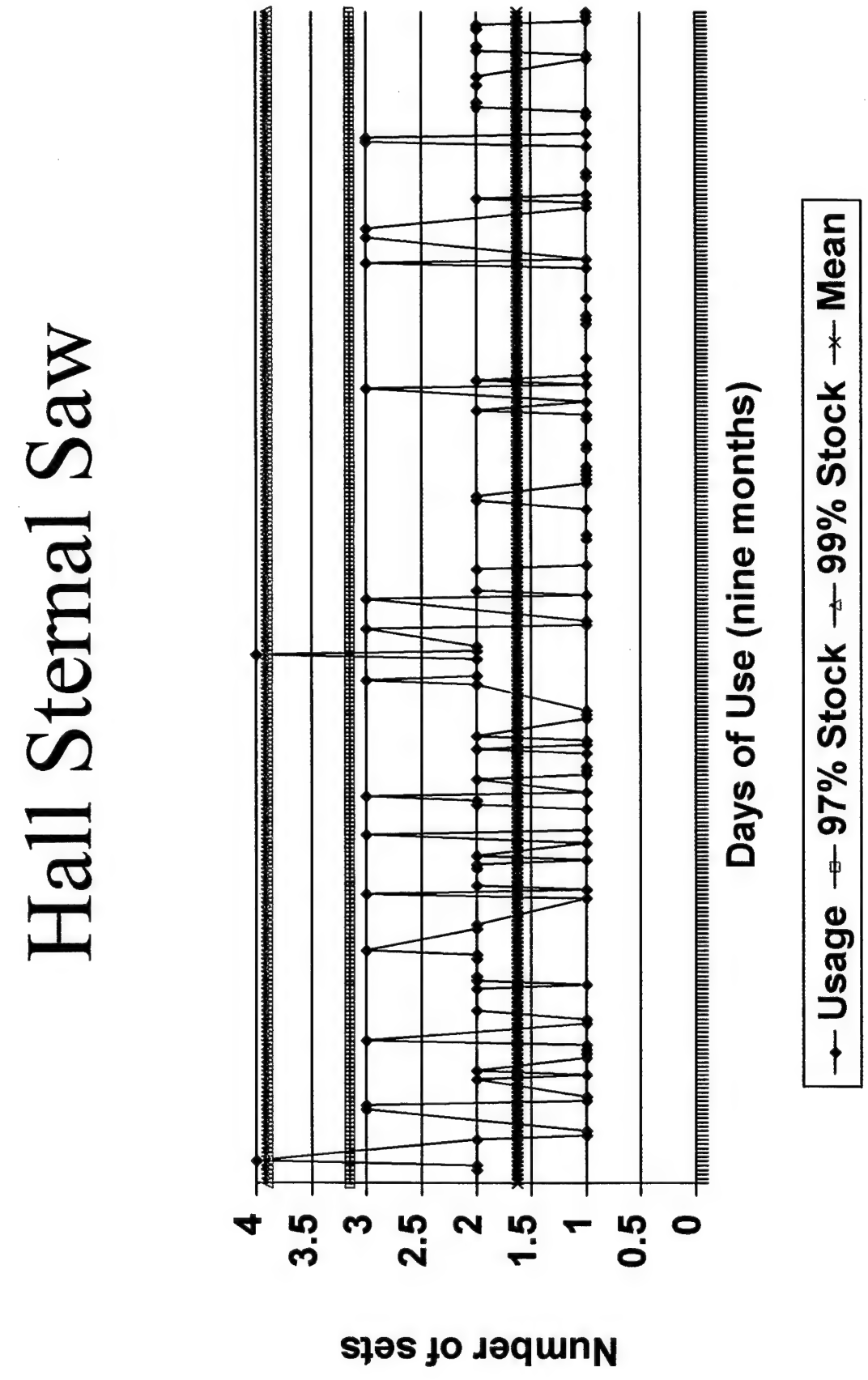
Laparoscope, Olympus, Diag. 10mm/0 Deg.



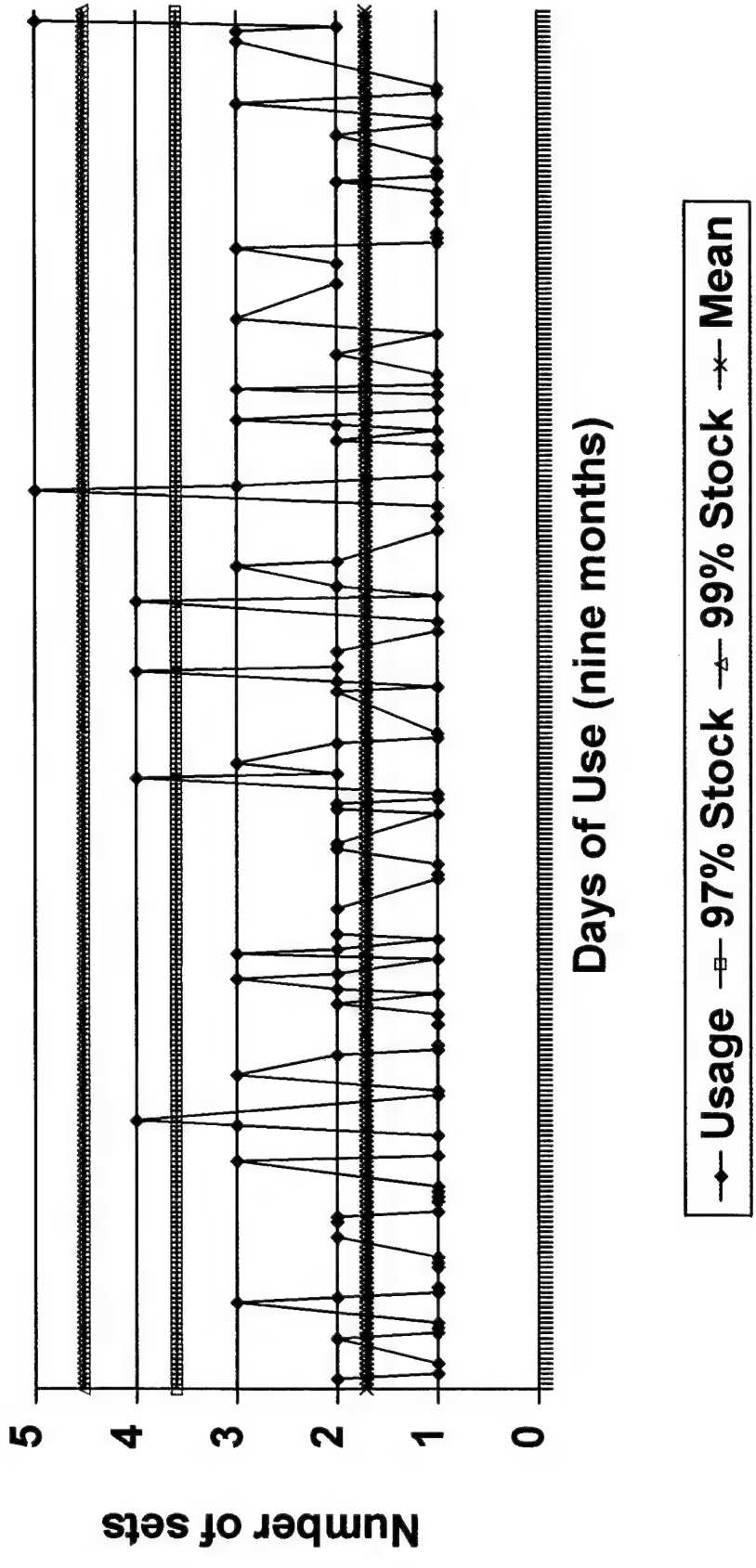
Arthroscopy Instrument Set



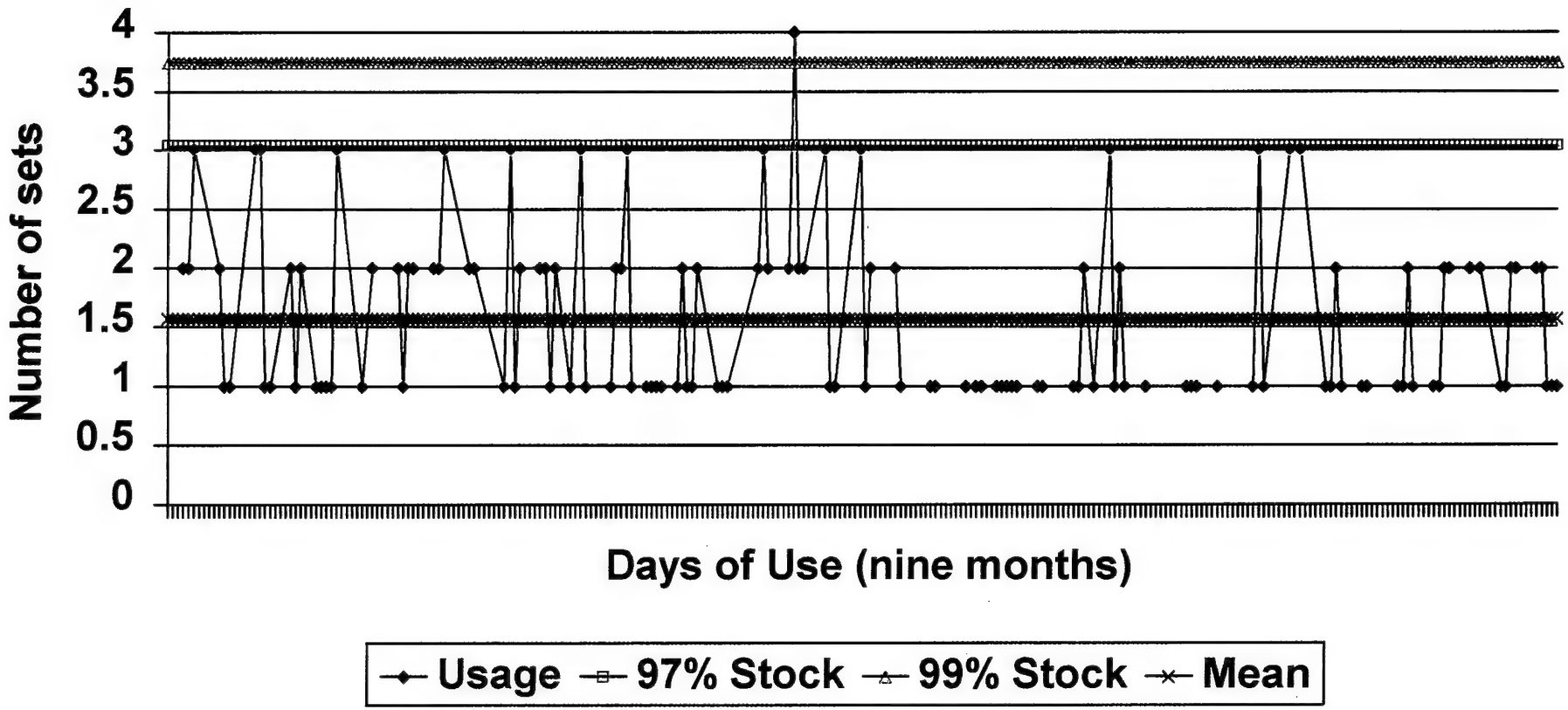

GYN Endoscopy Instruments
Number of sets
9
8
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean


Hall Stemal Saw
Number of sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

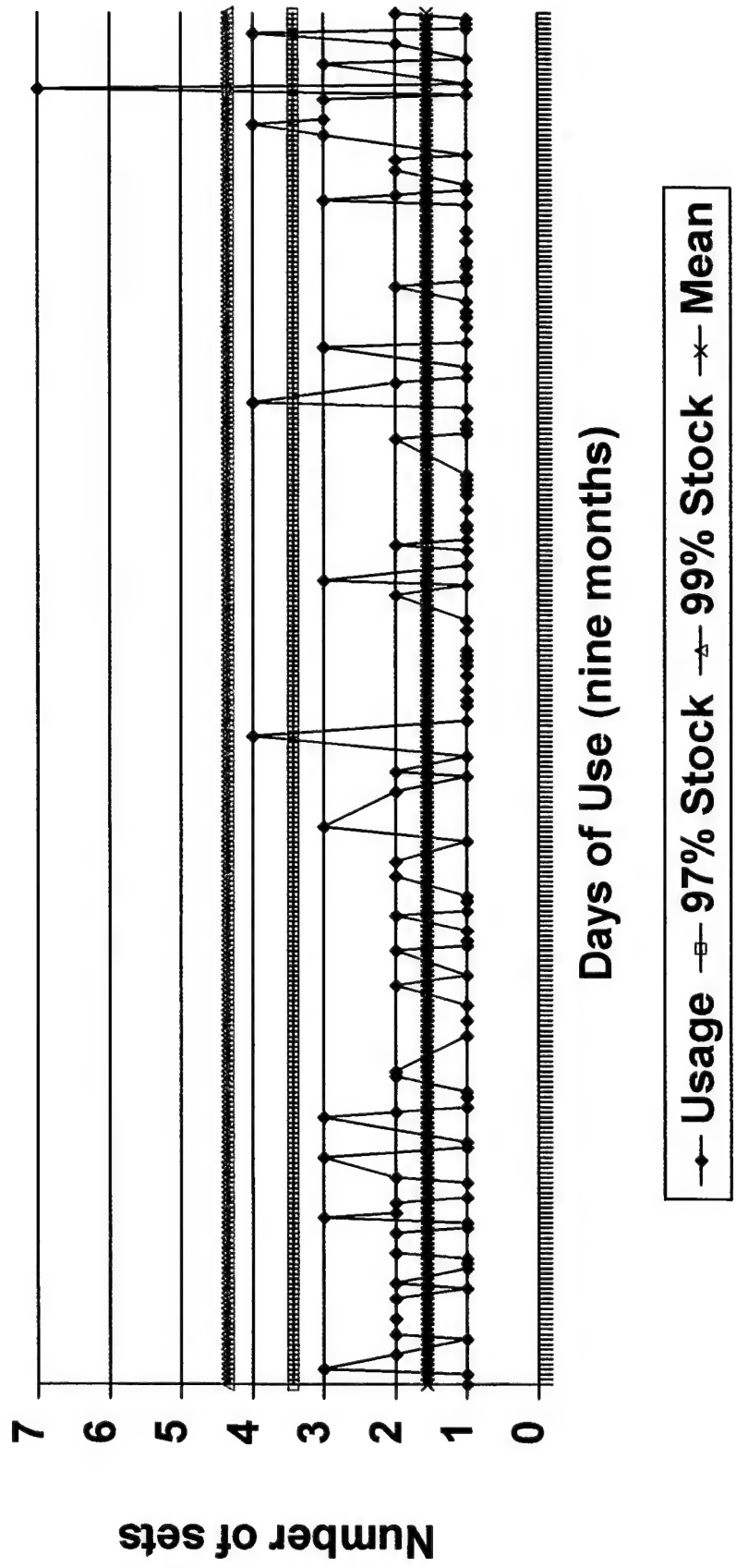
Baby Laparotomy Set



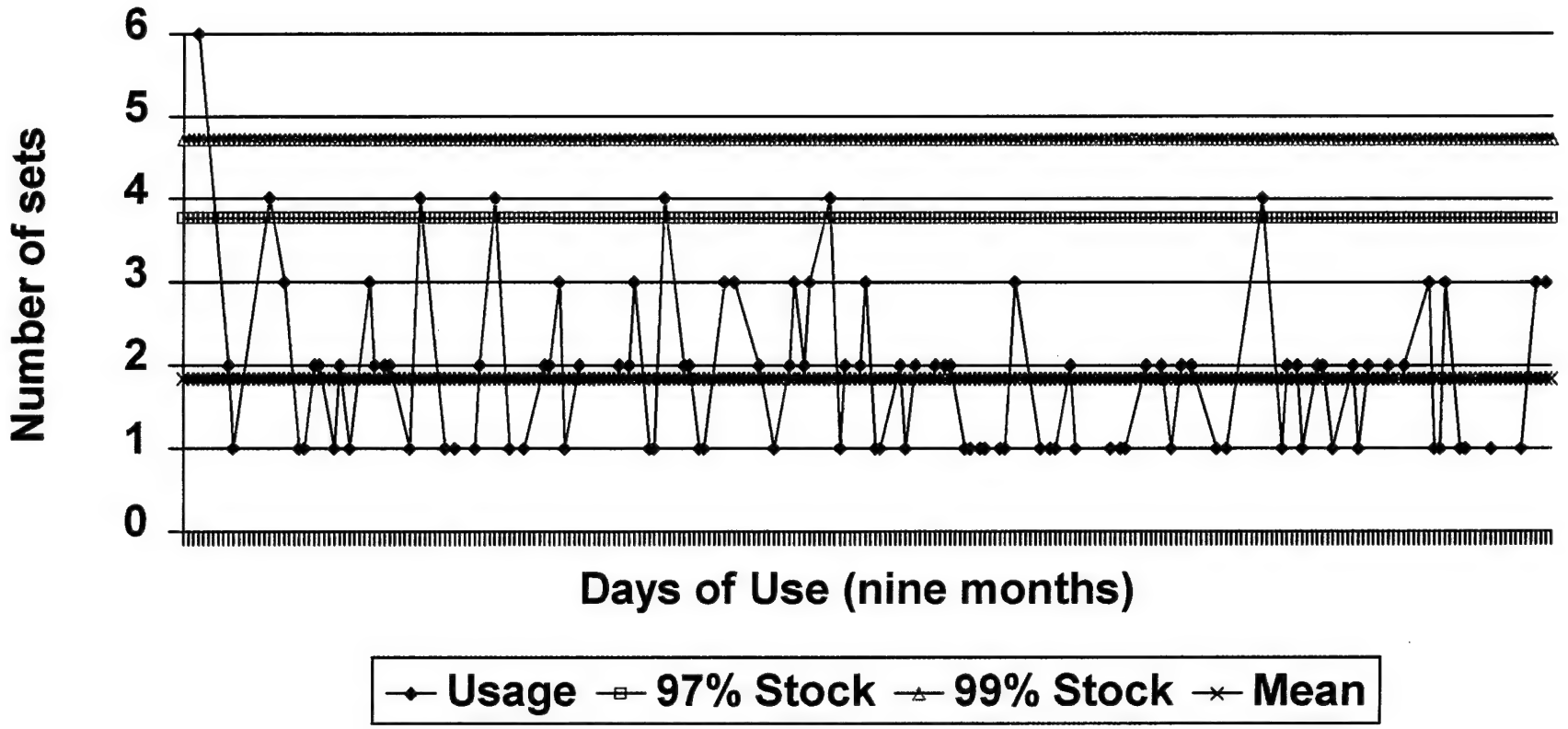
Open Heart Chest Tray

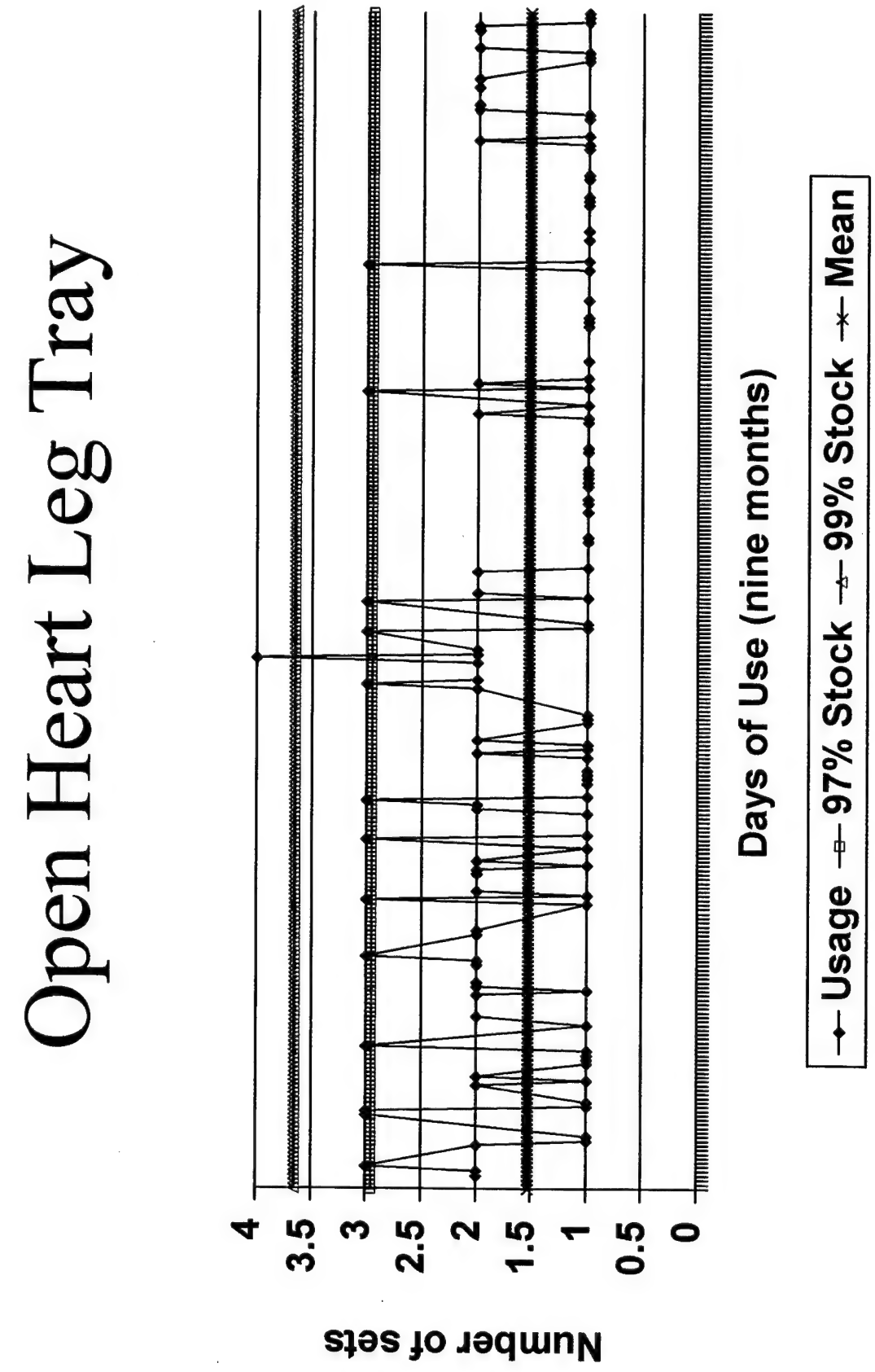


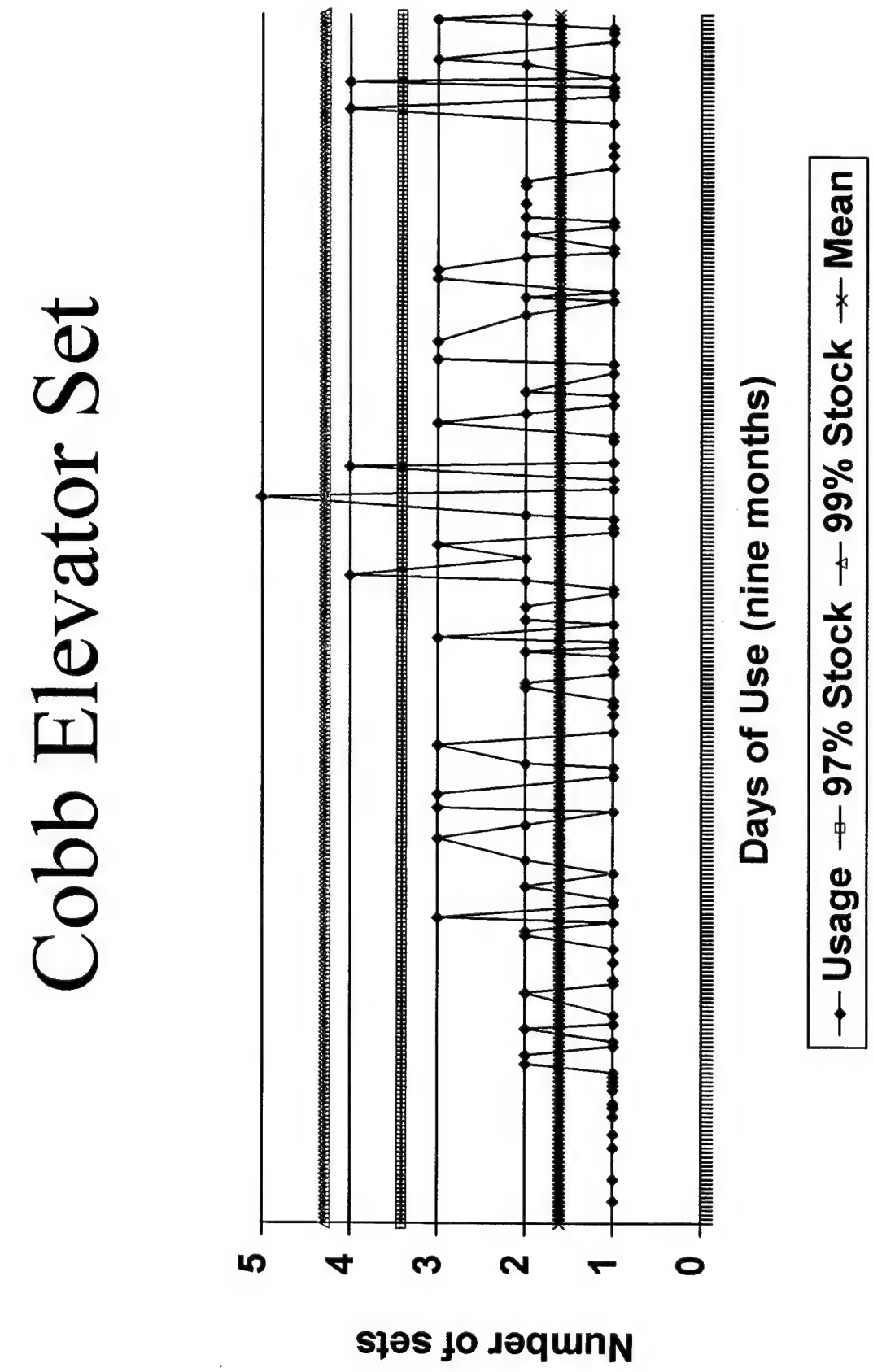
Maxi Driver

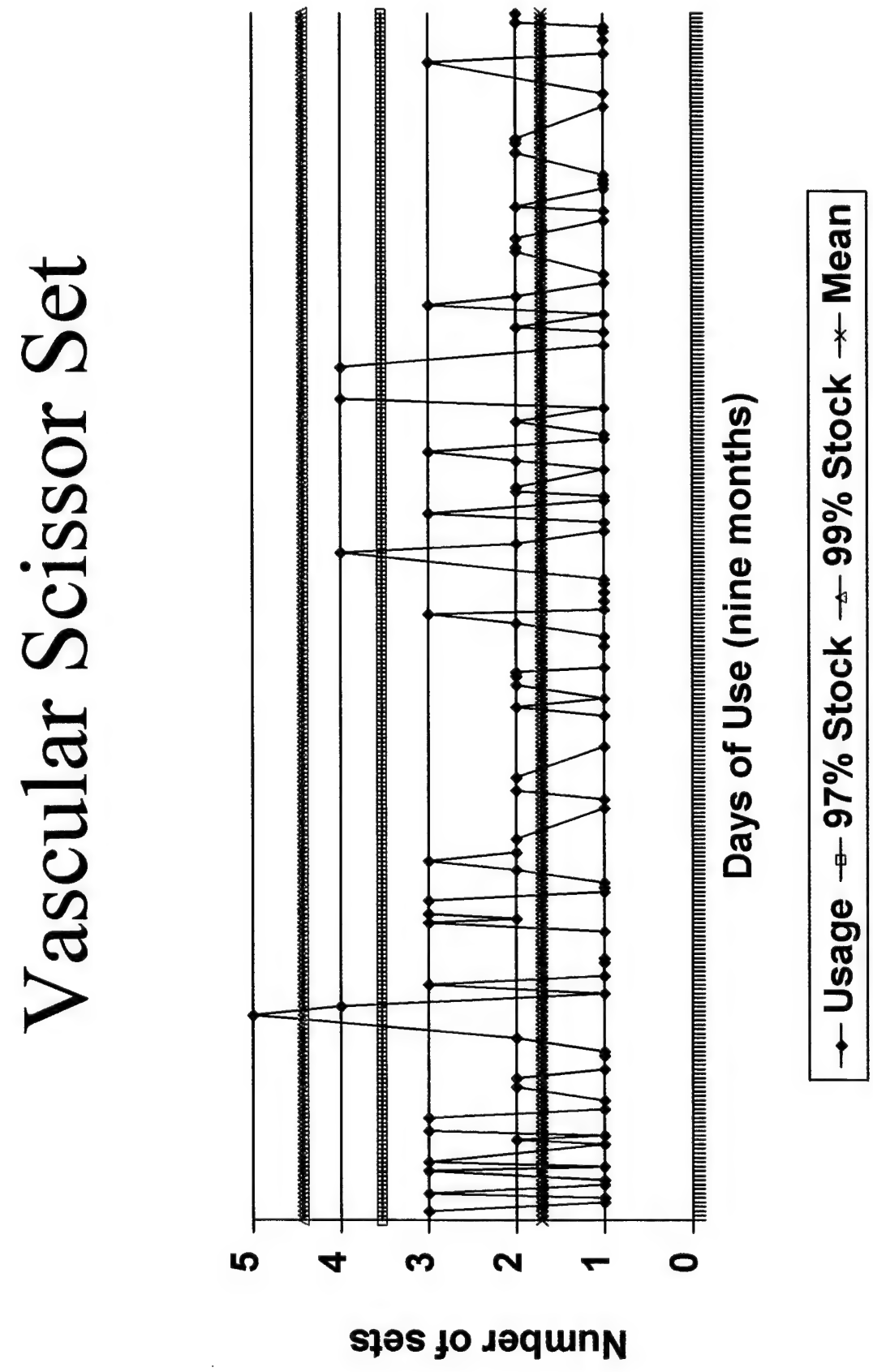

Number of sets
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

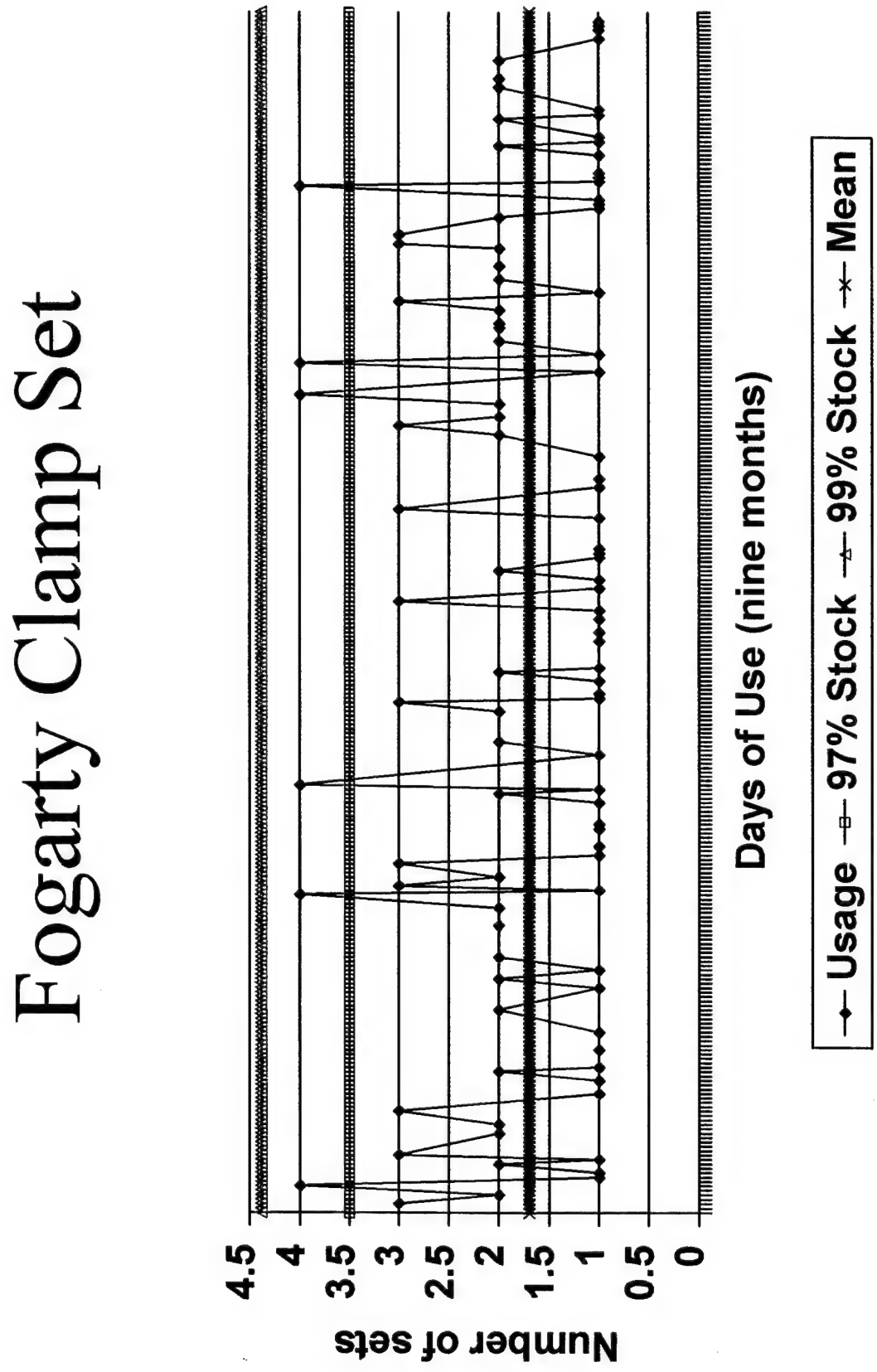
Balfour Retractor



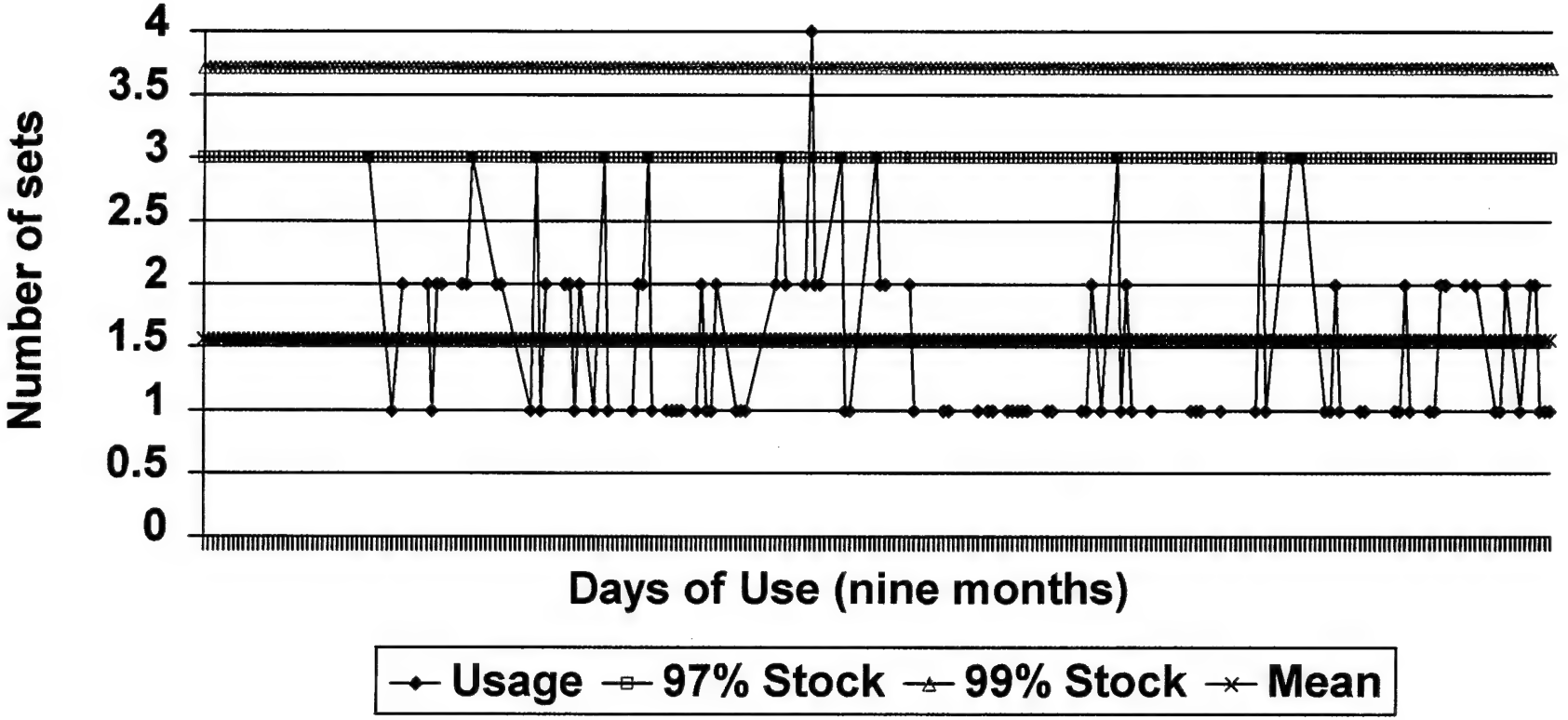

Open Heart Leg Tray
Number of sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

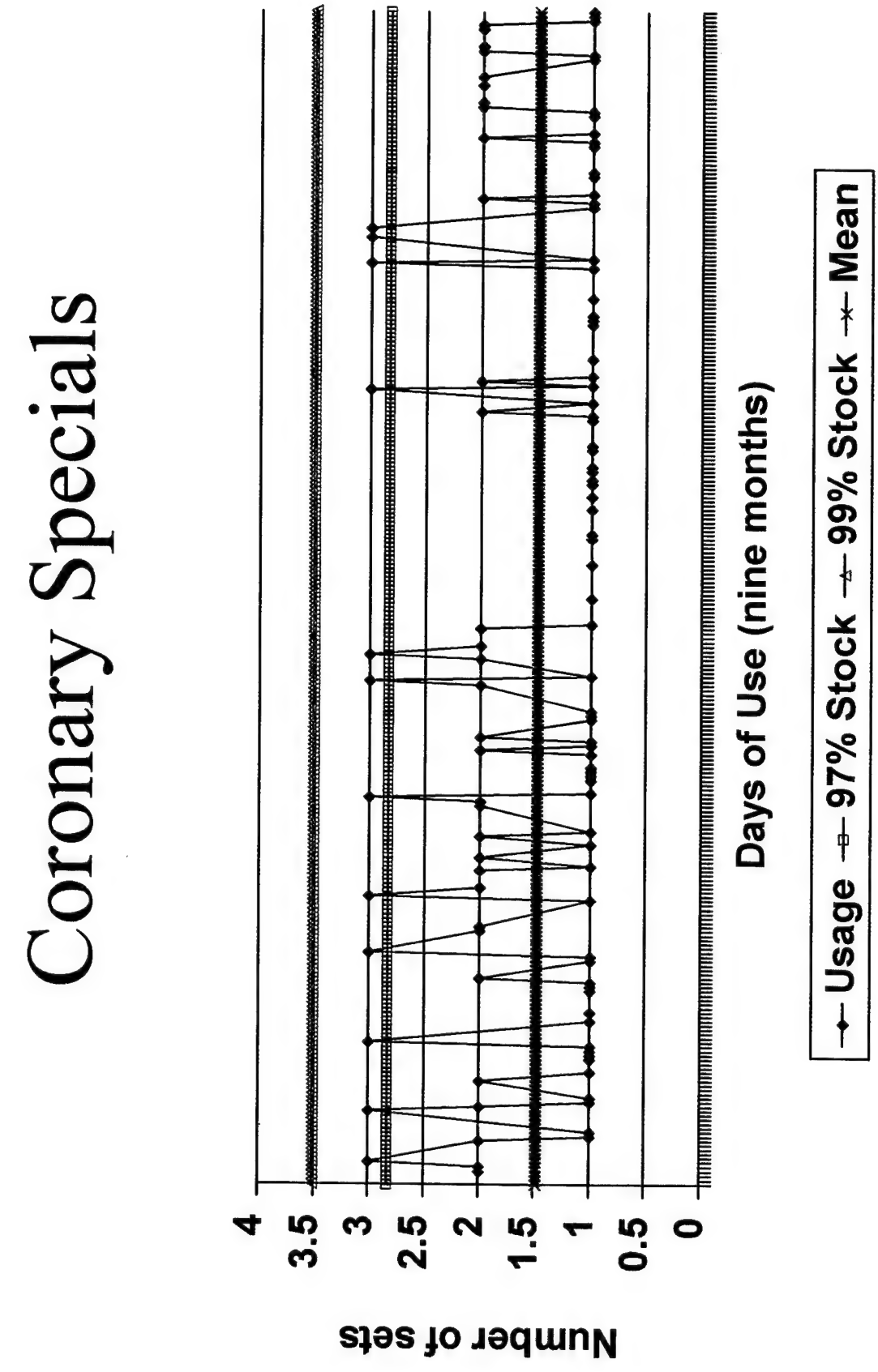

Cobb Elevator Set
Number of sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

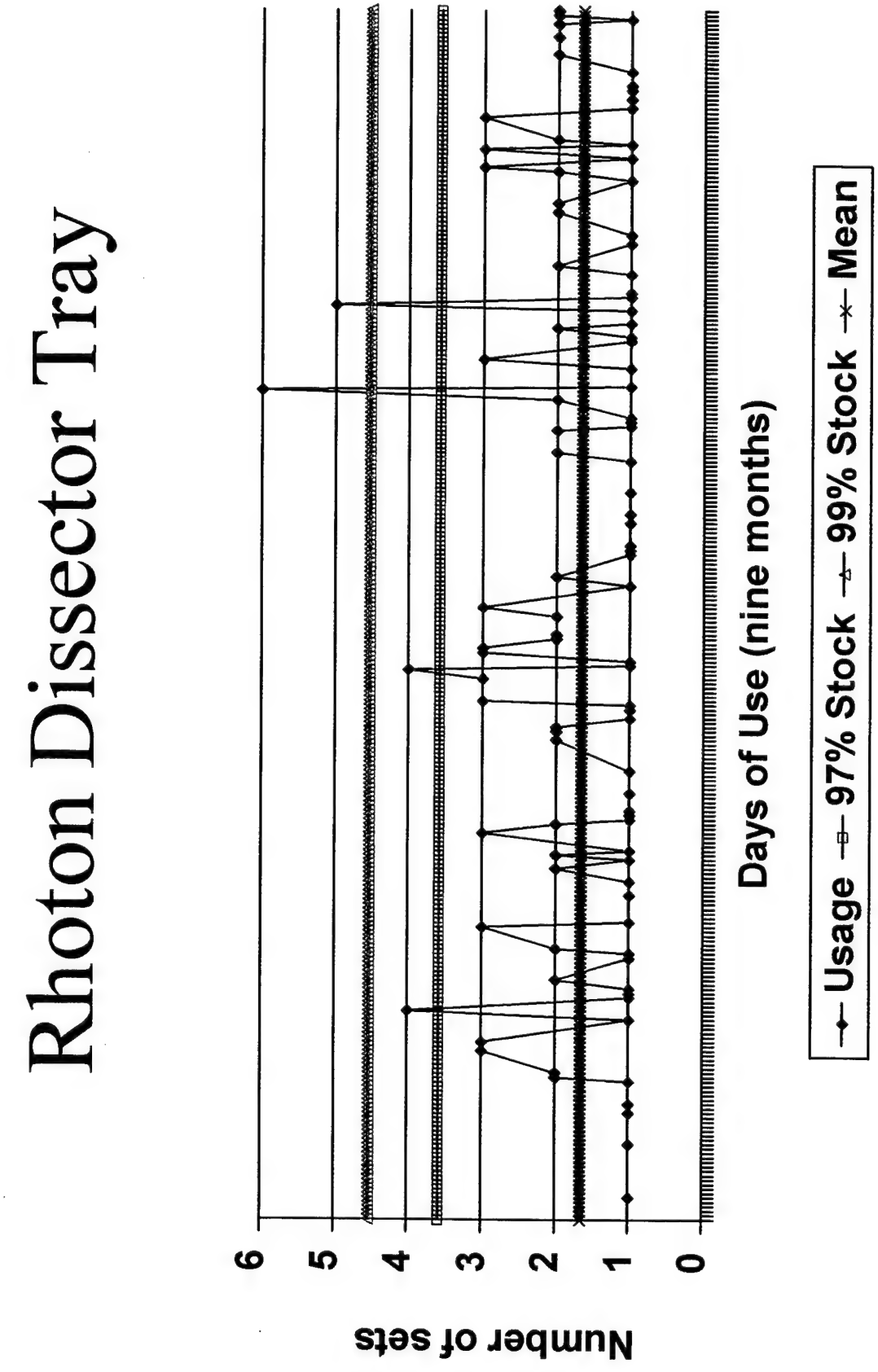

Vascular Scissor Set
Number of sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

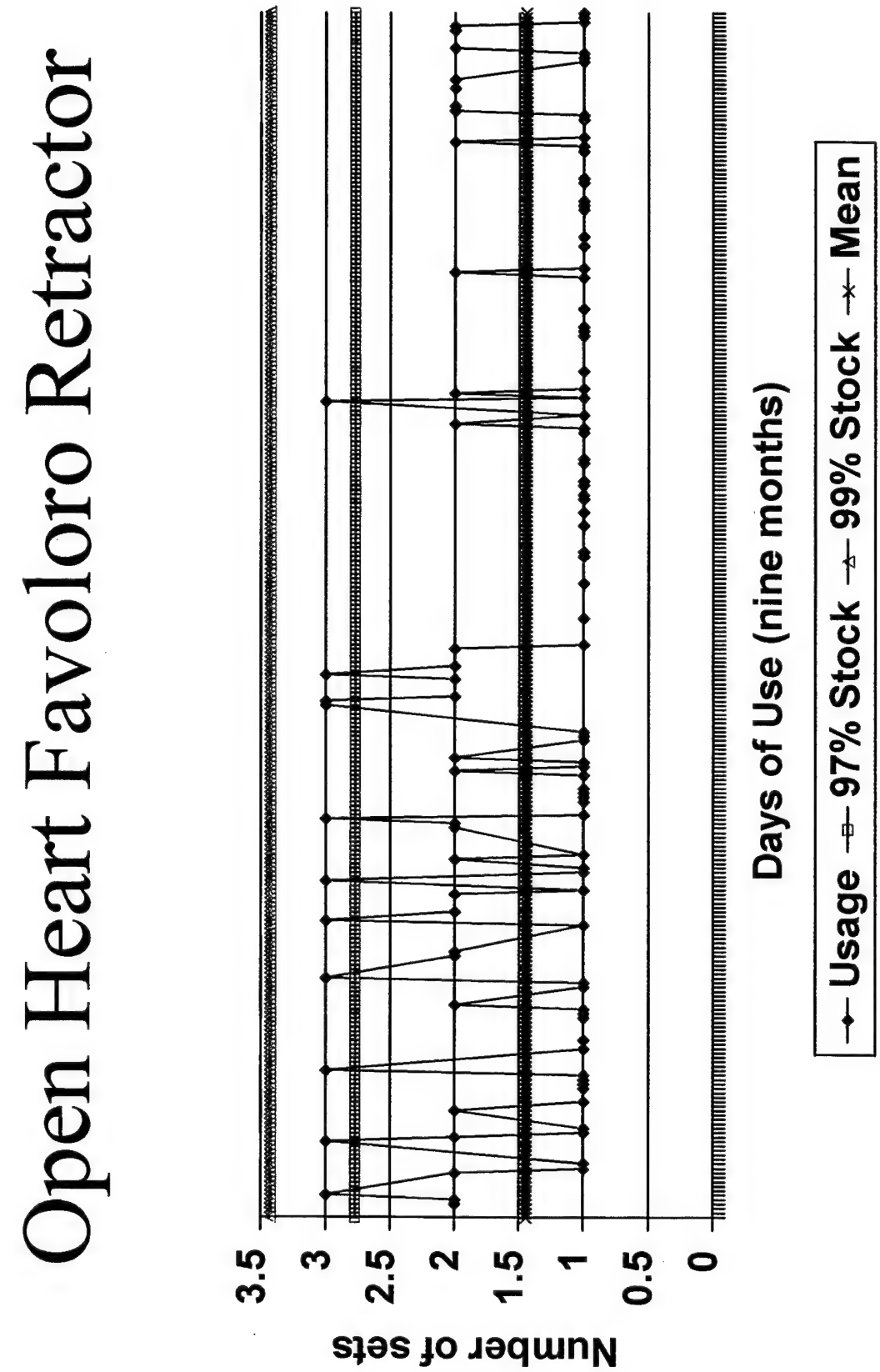

Fogarty Clamp Set
Number of sets
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Siemans Internal Defib. Paddles

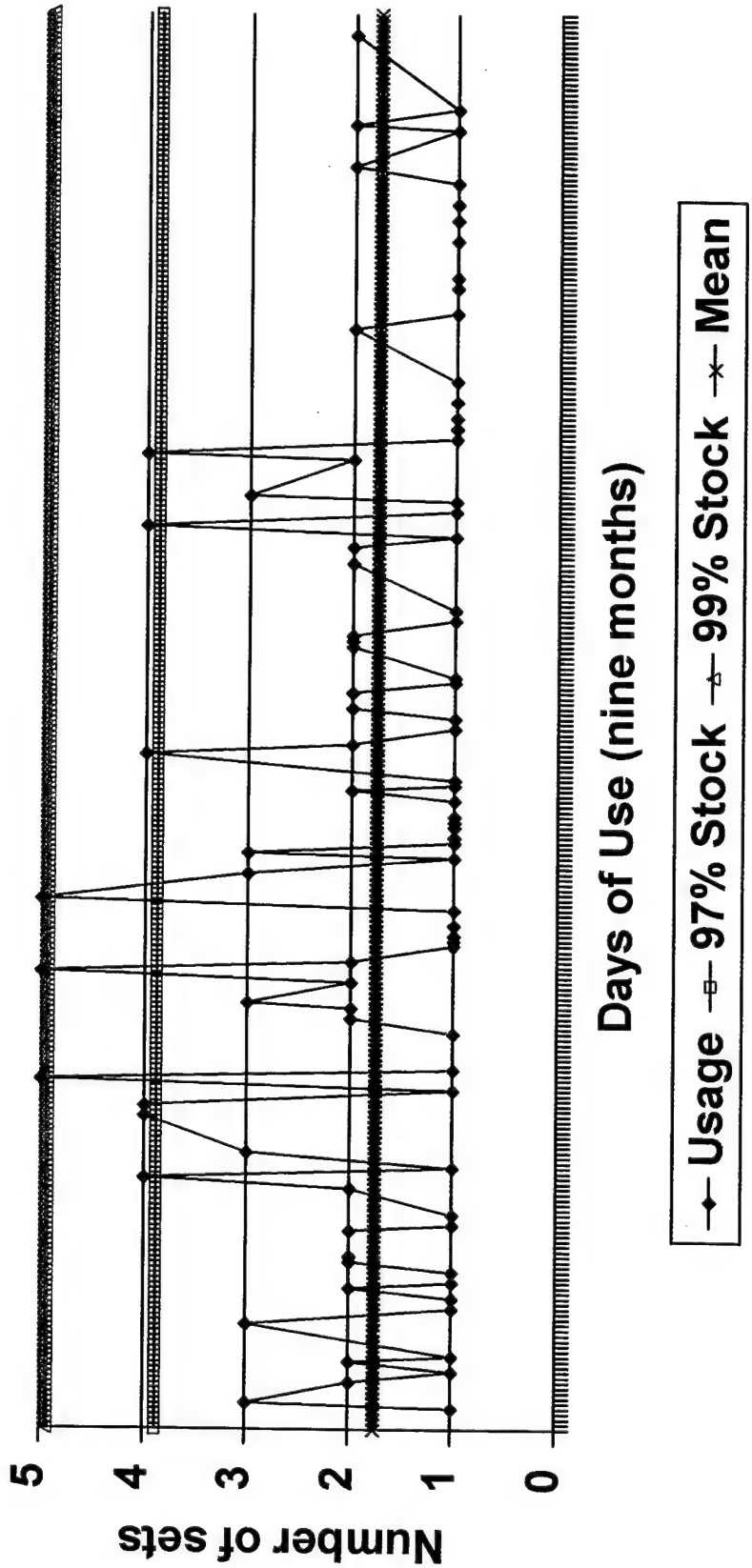



Coronary Specials
Number of sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

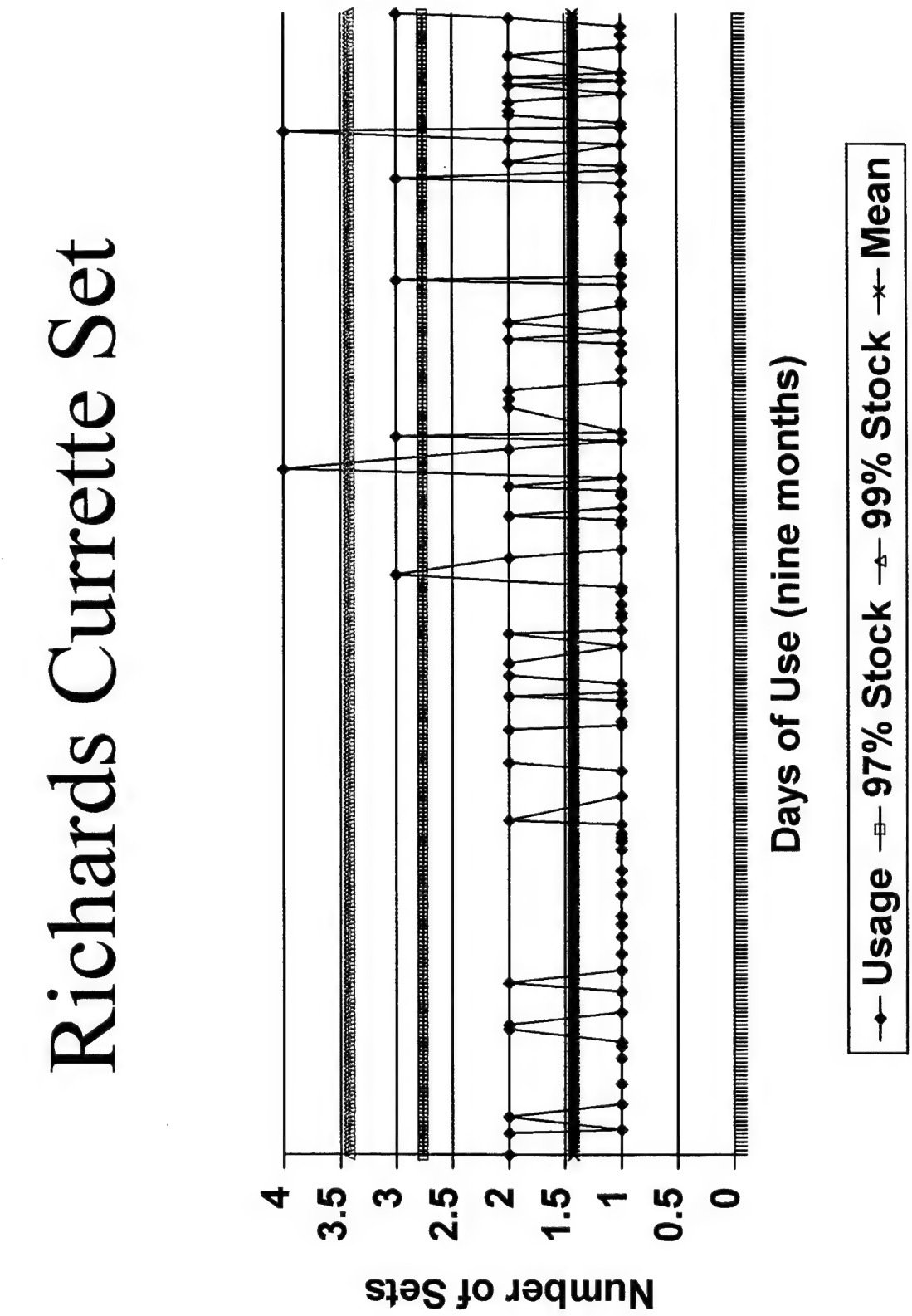

Rhoton Dissector Tray
Number of sets
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean


Open Heart Favoloro Retractor
Number of sets
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

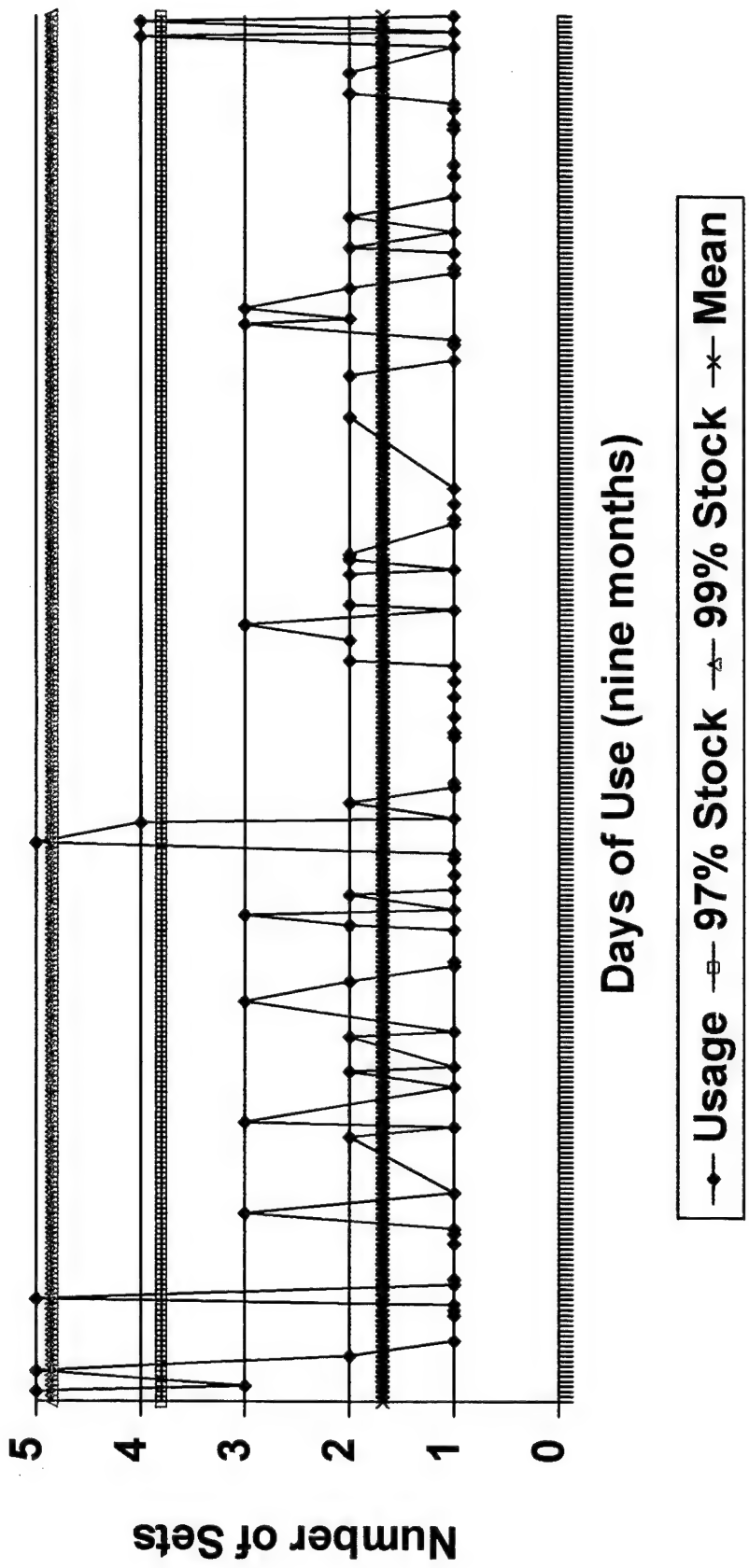
ENT Basic Set



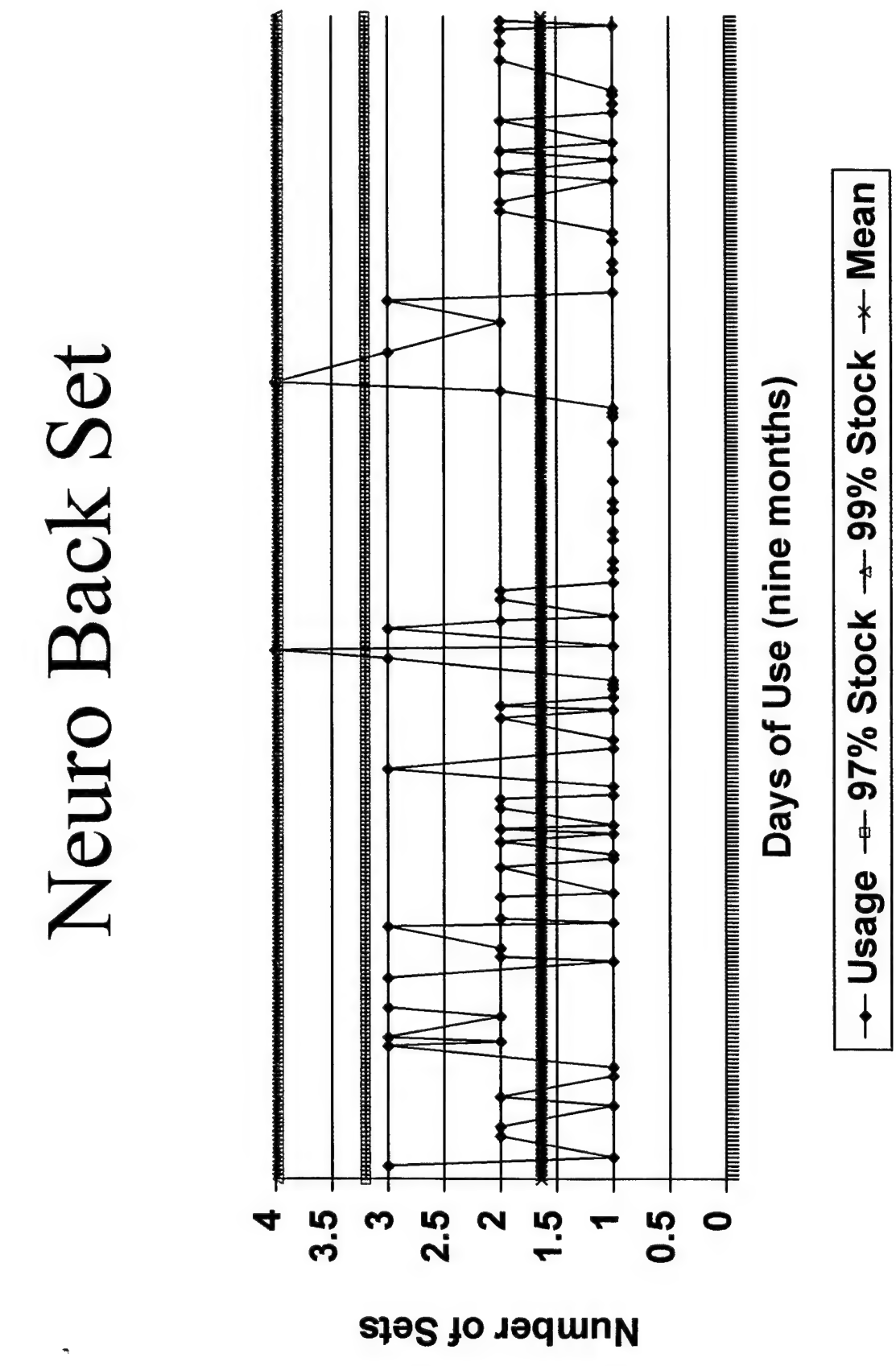
Richards Currette Set

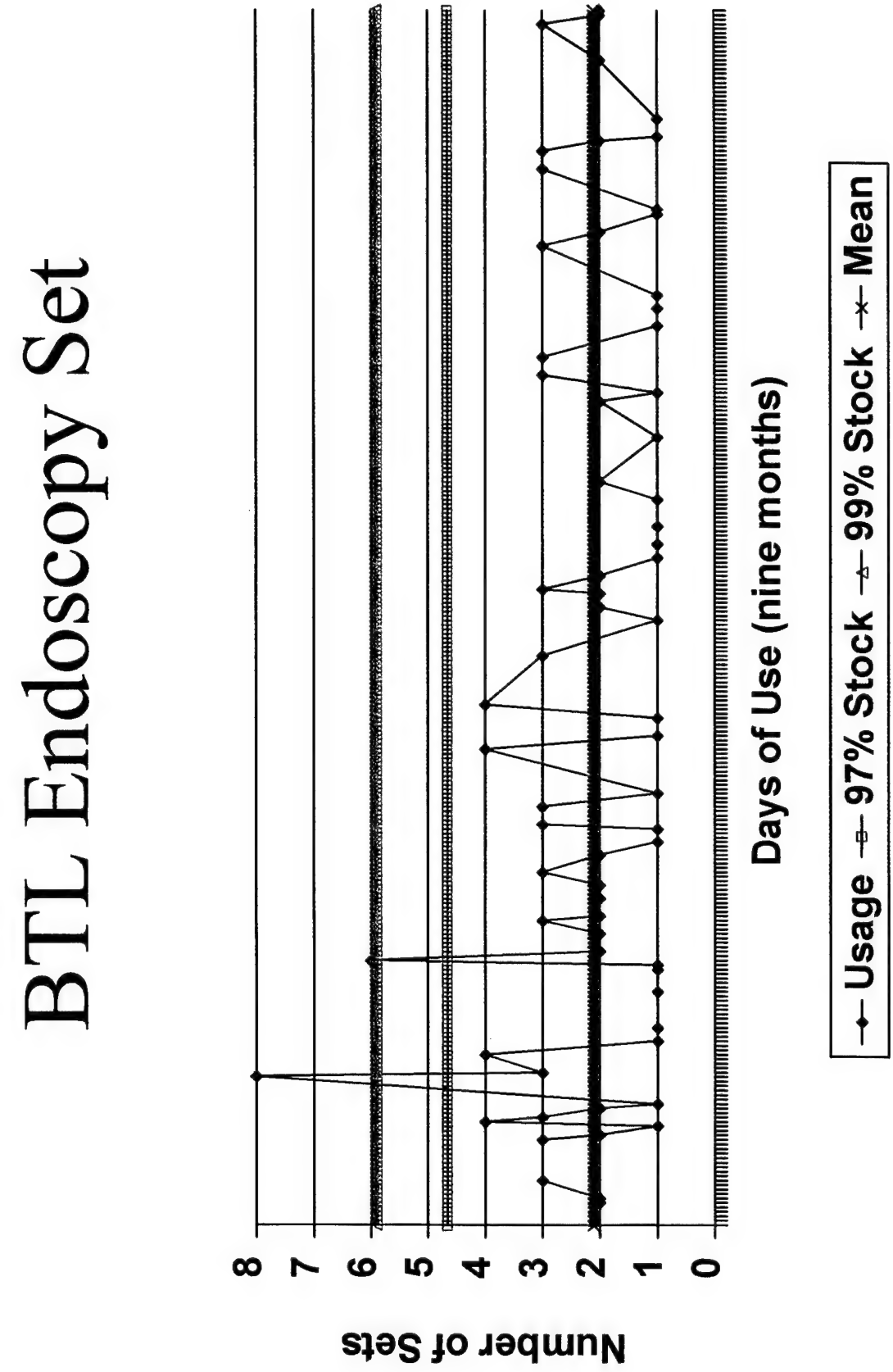


TVH Set

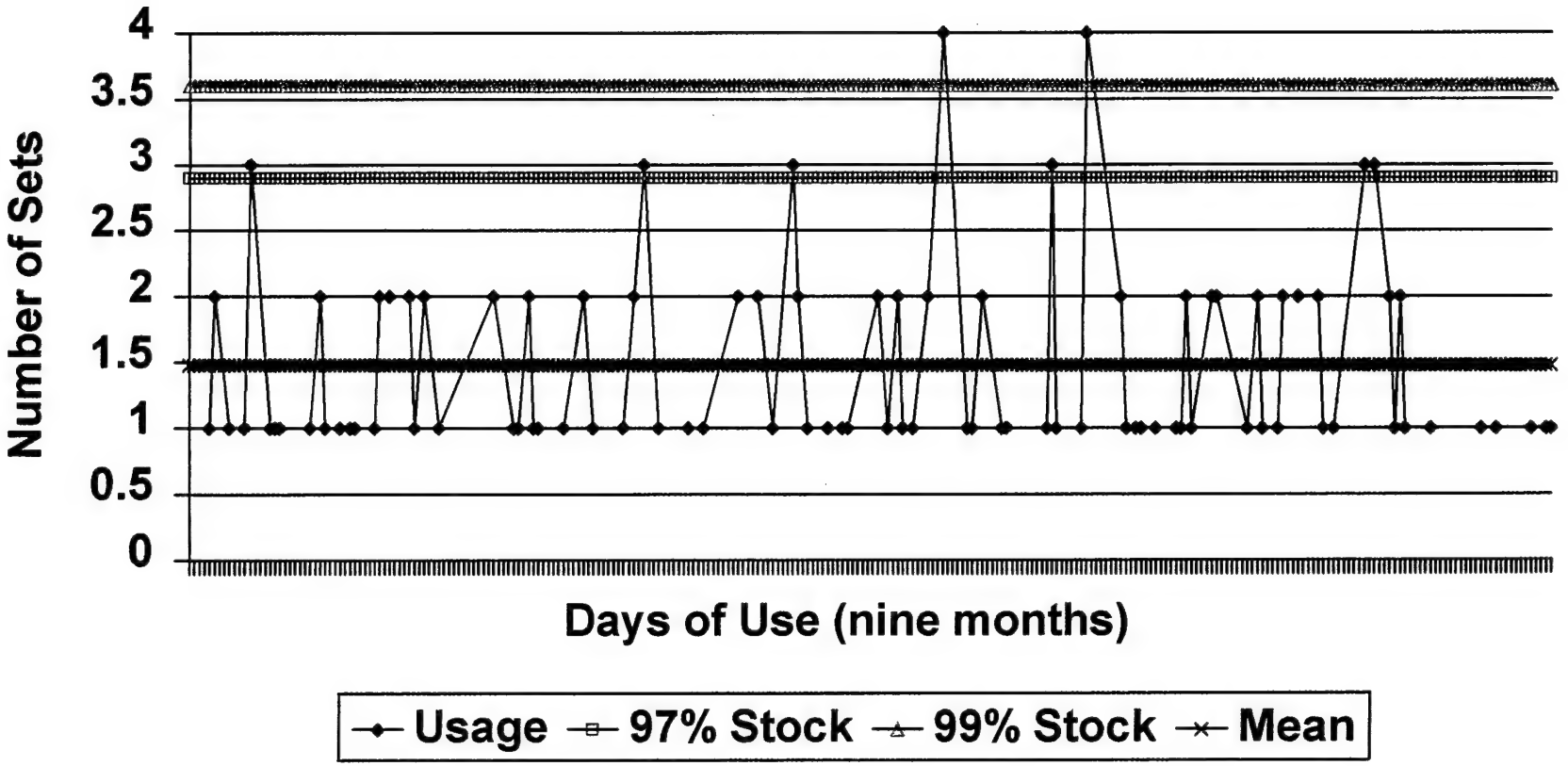

Number of Sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Neuro Back Set

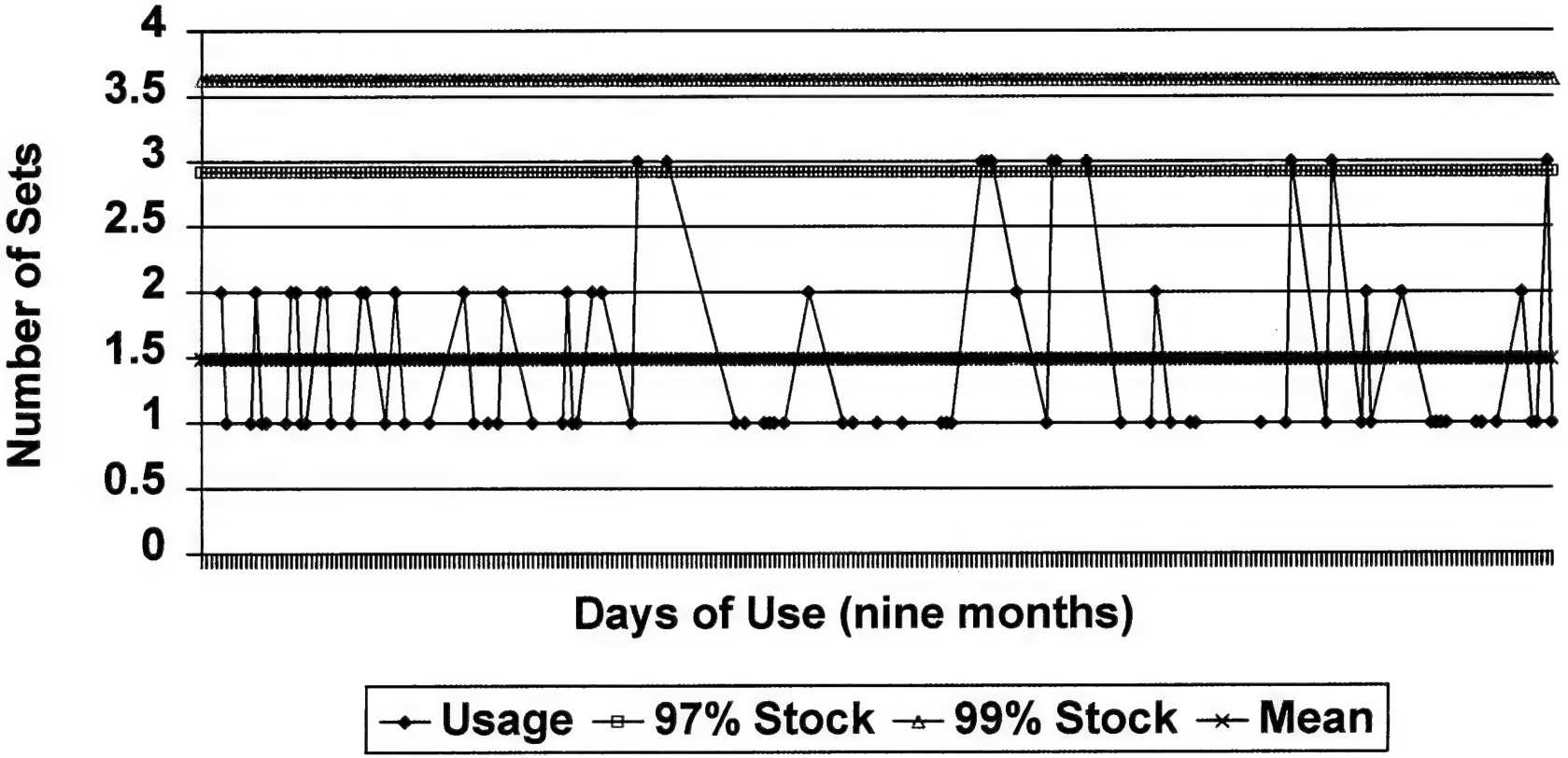


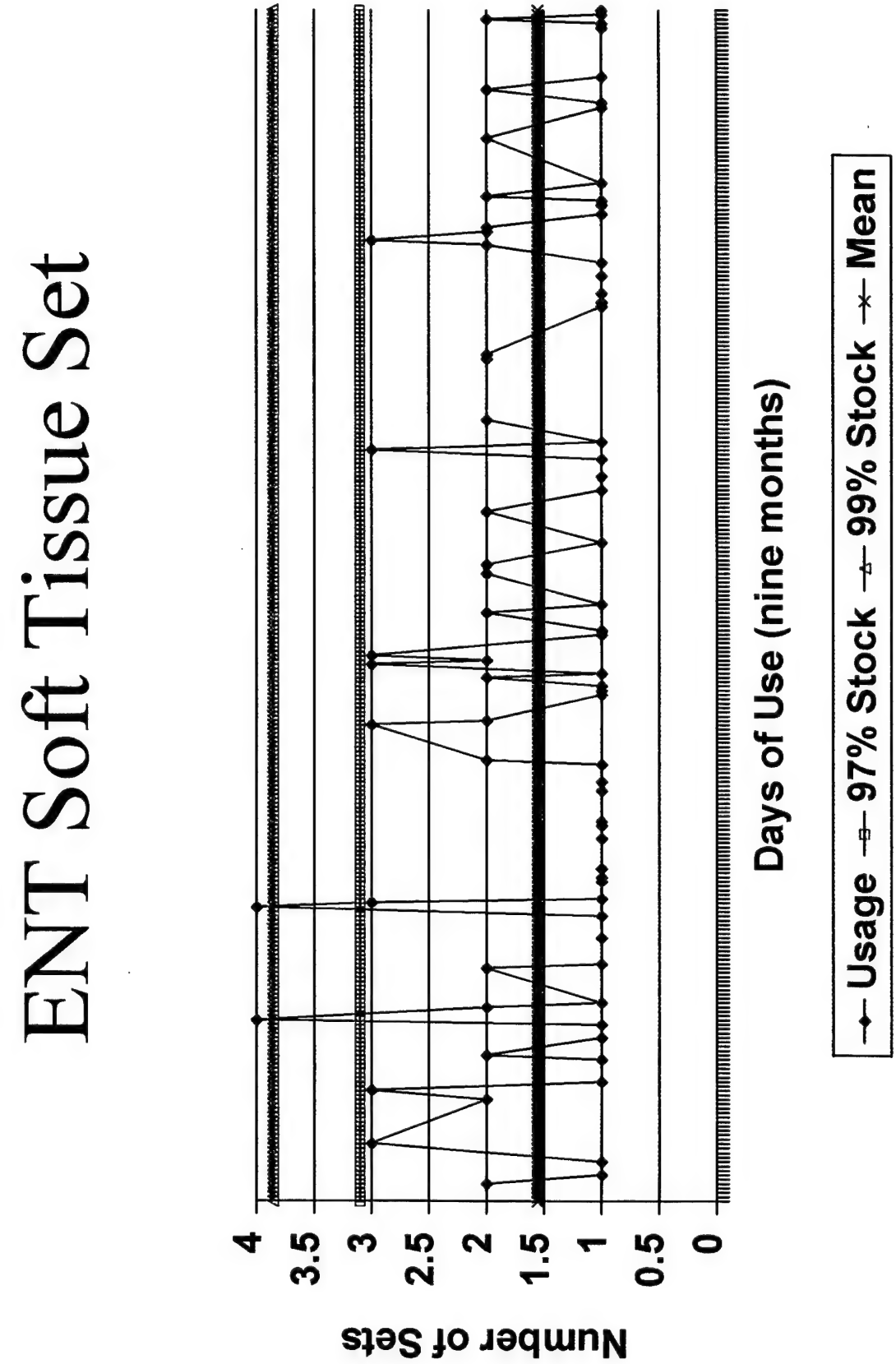

BTL Endoscopy Set
Number of Sets
8
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Neuro Rongeur Pan

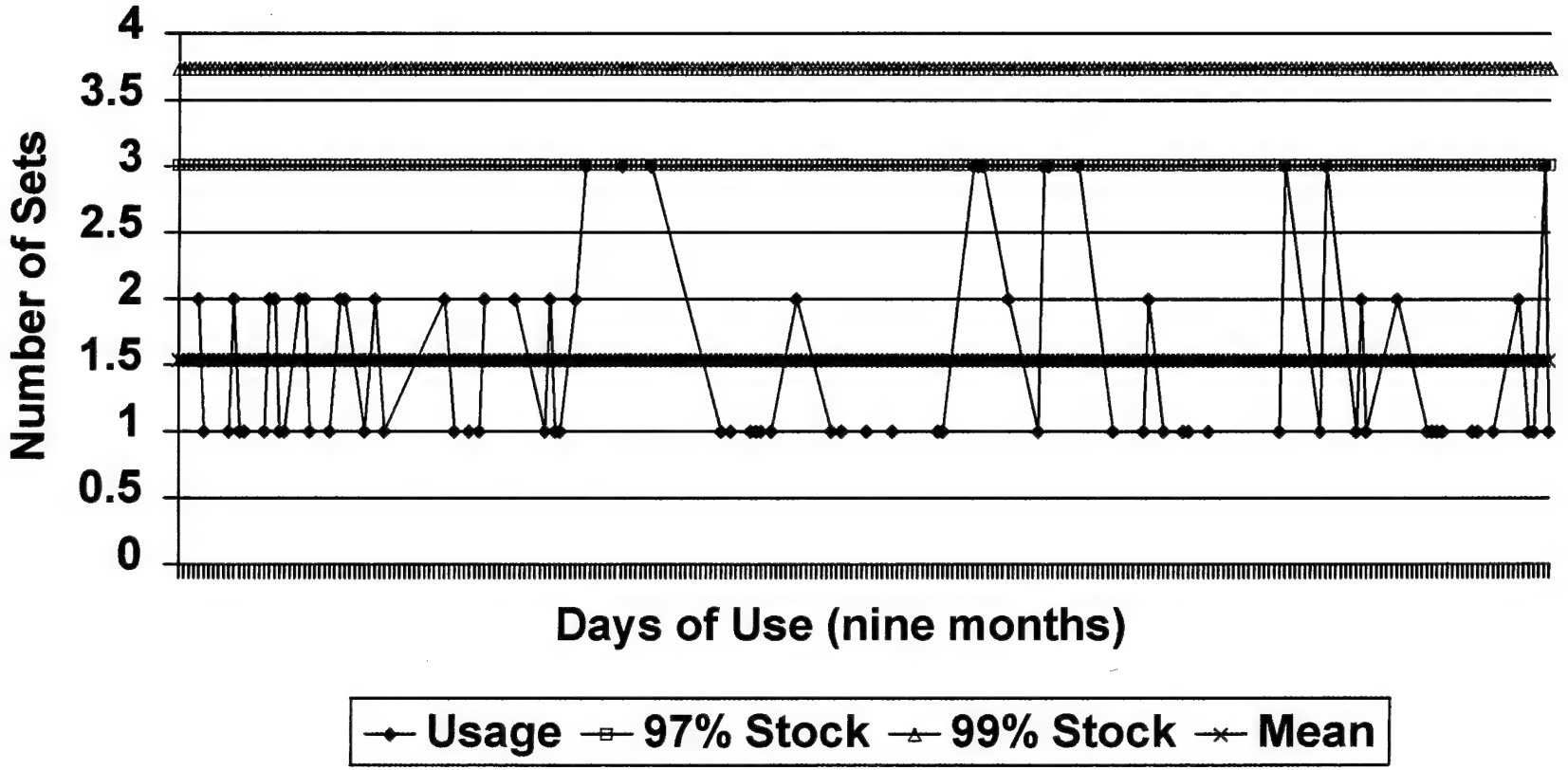


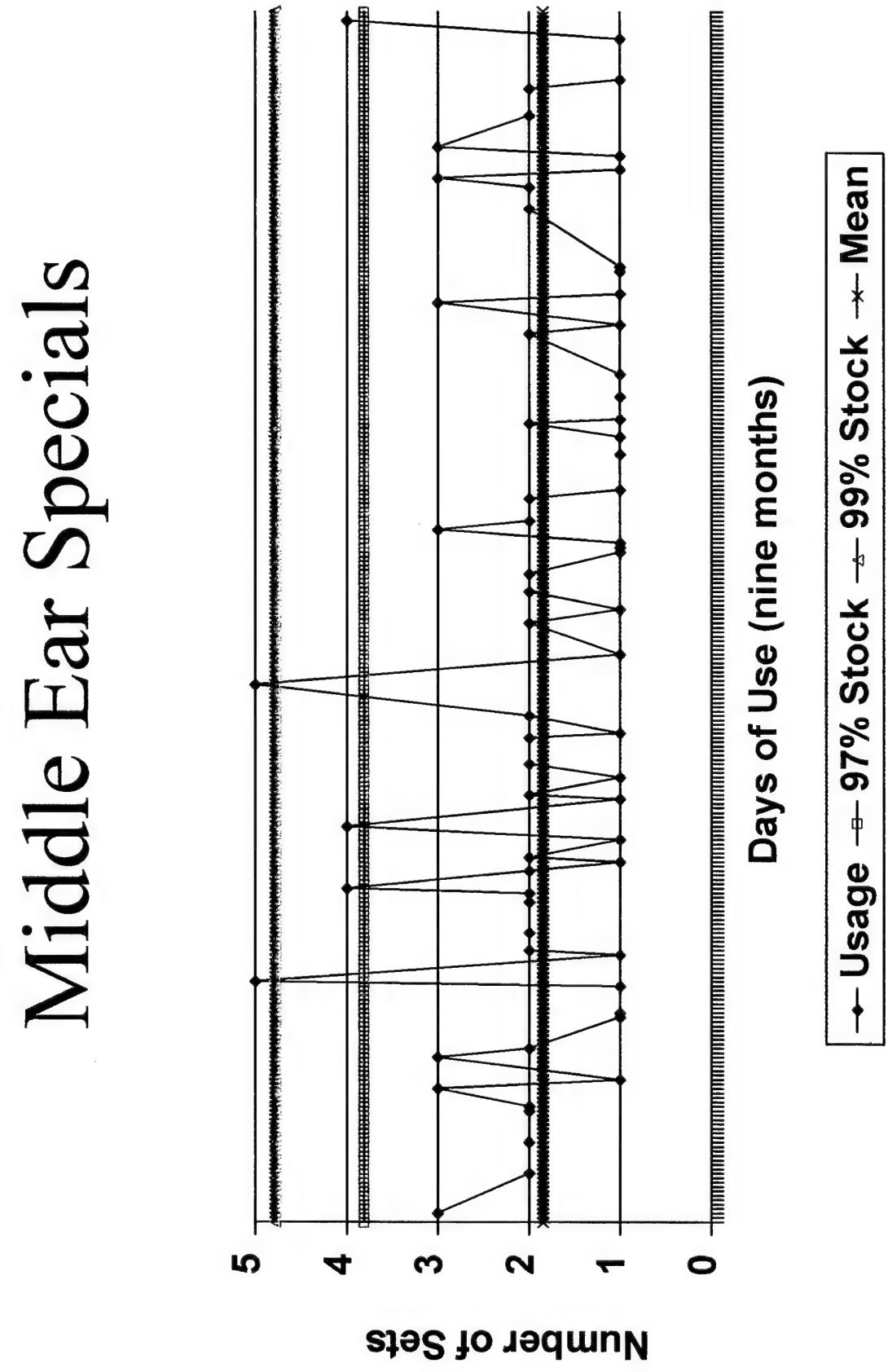
Thoracotomy Retractors



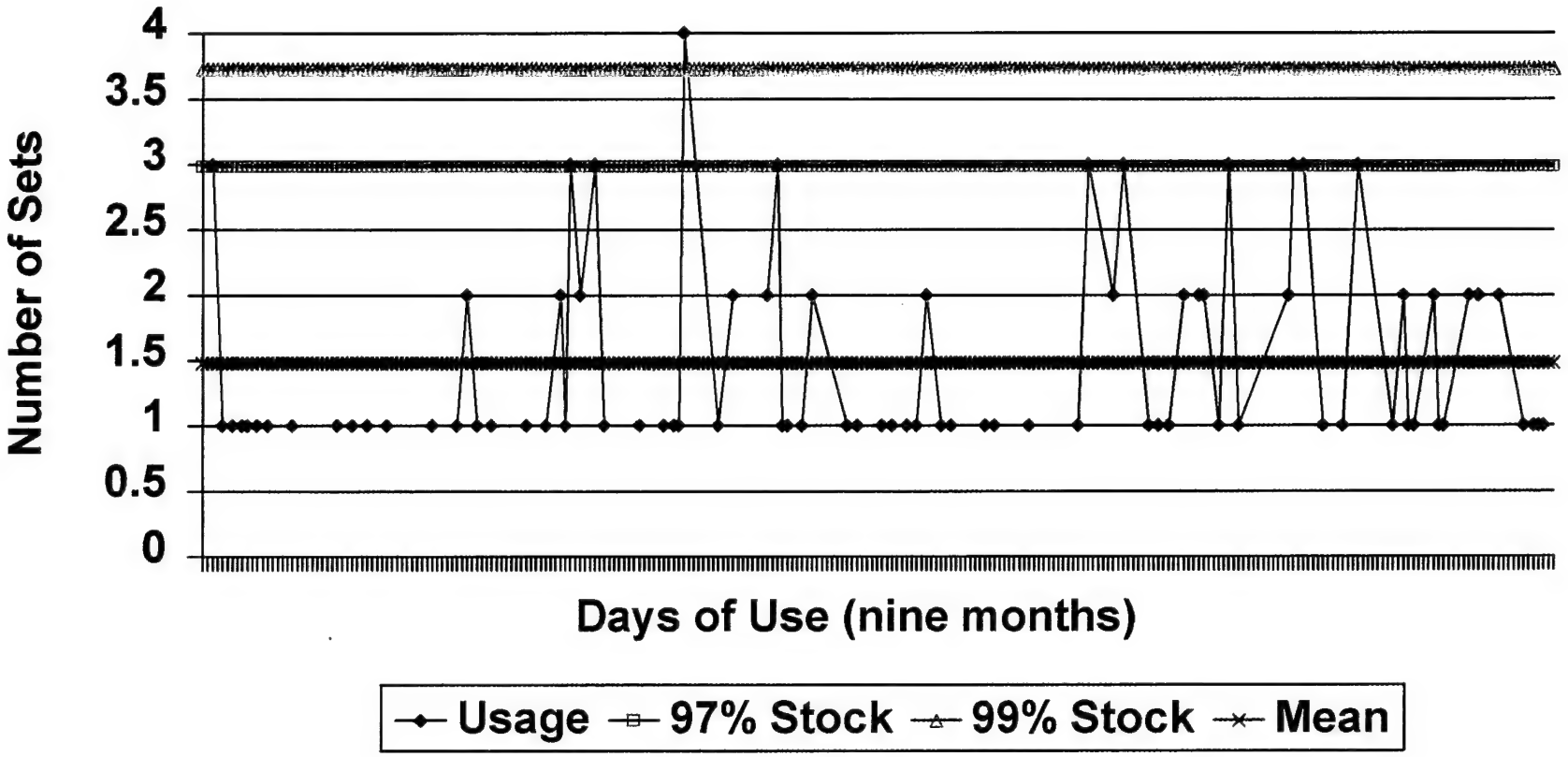

ENT Soft Tissue Set
Number of Sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

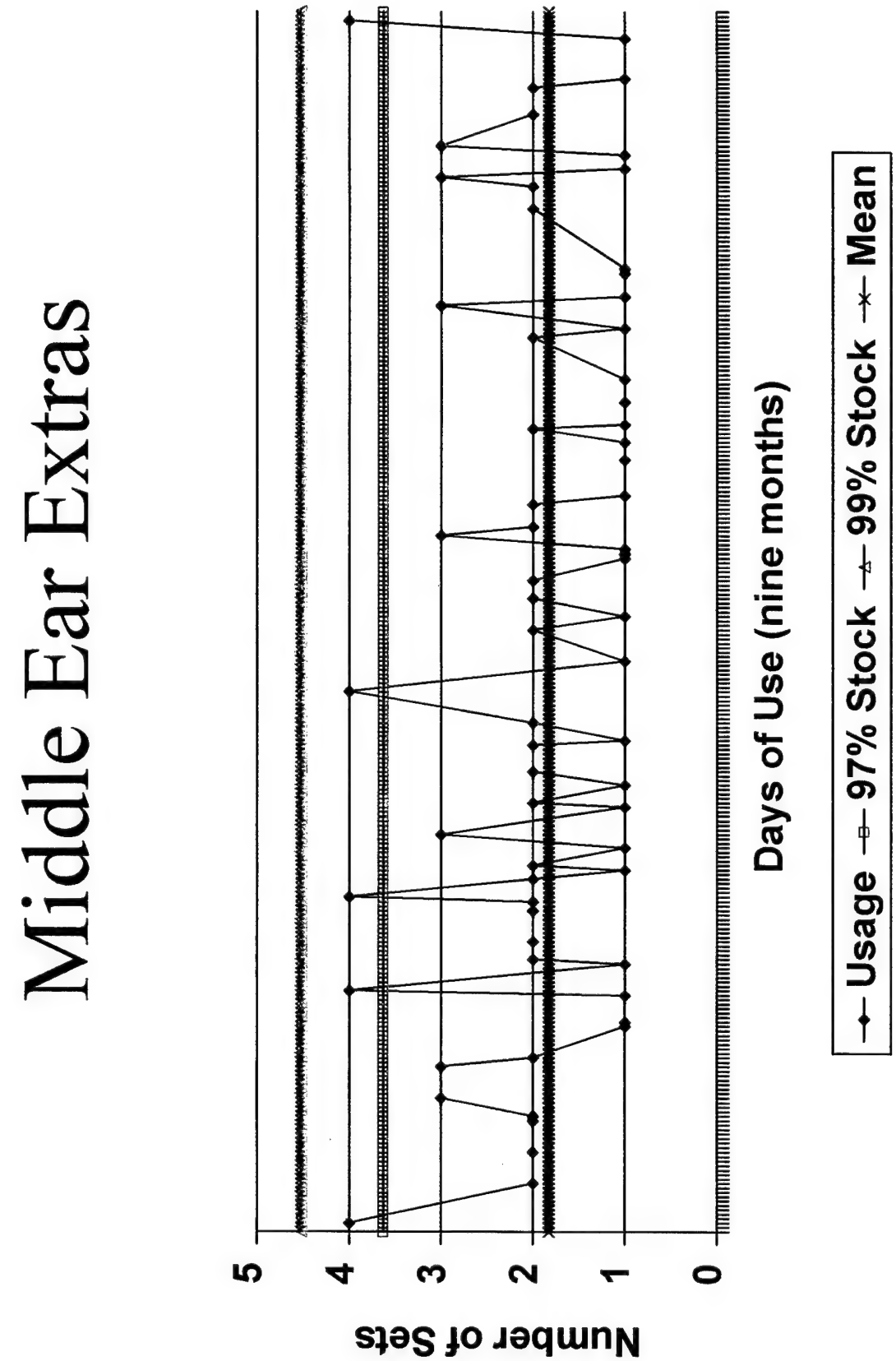
Thoracotomy Specials



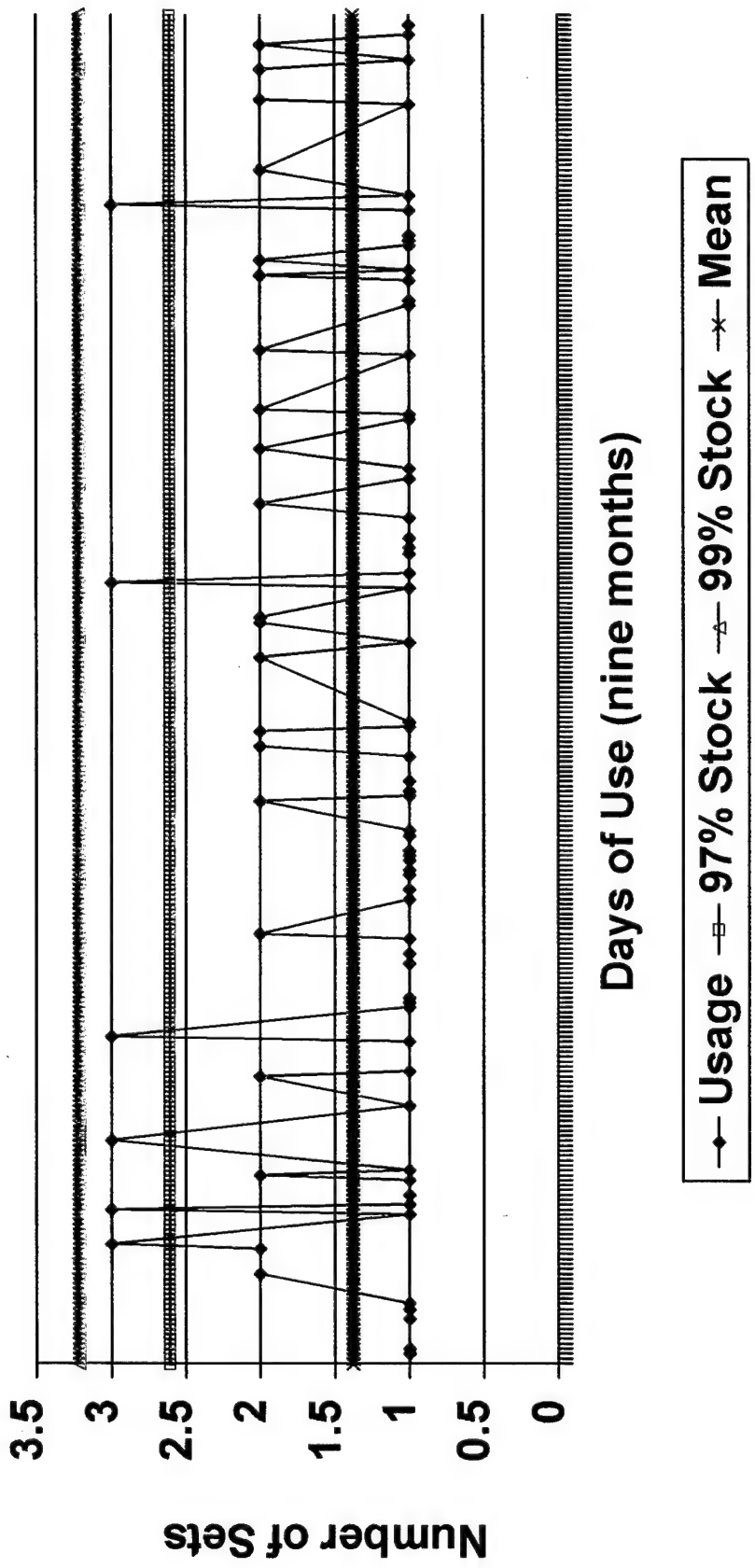

Middle Ear Specials
Number of Sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Vascular Graft Set

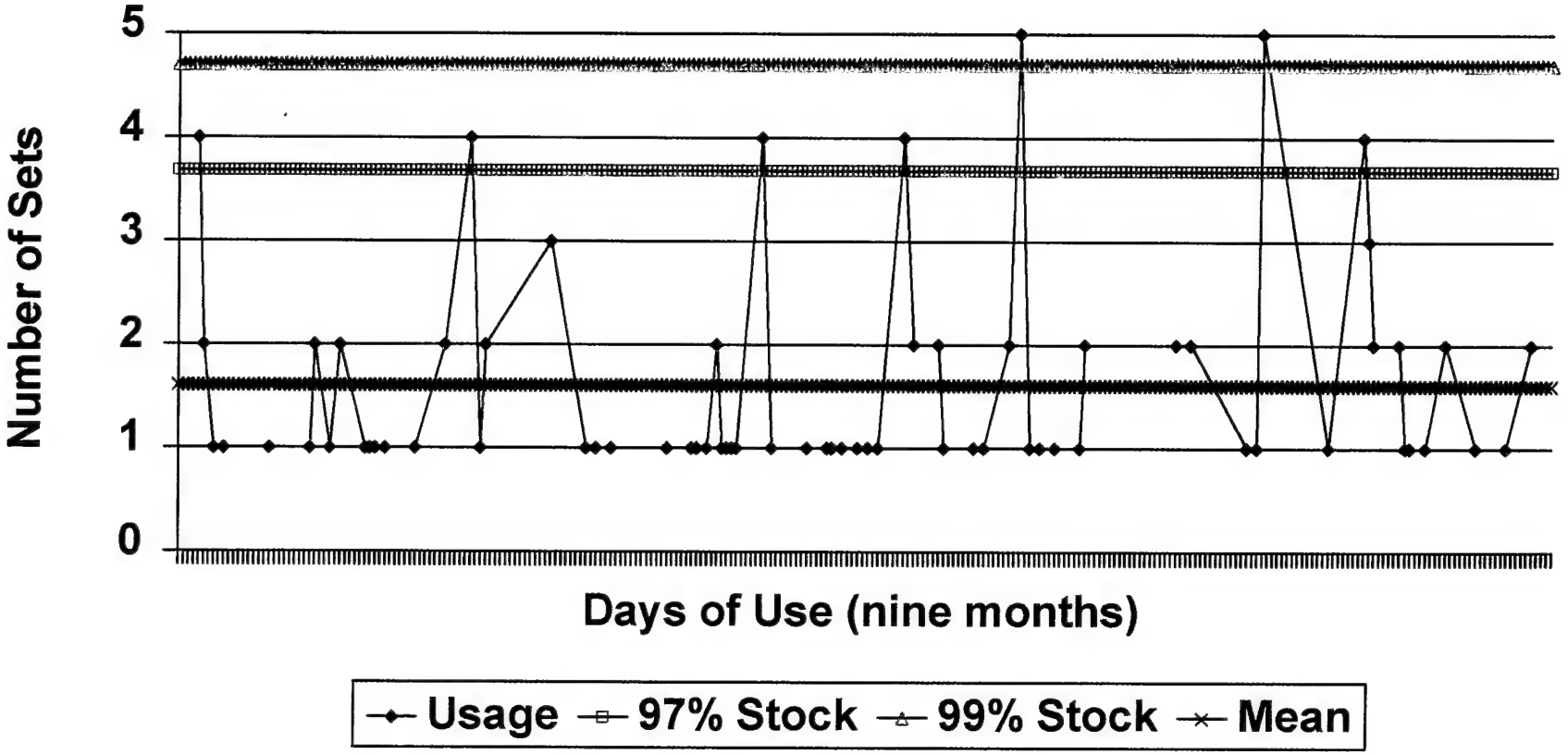



Middle Ear Extras
Number of Sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

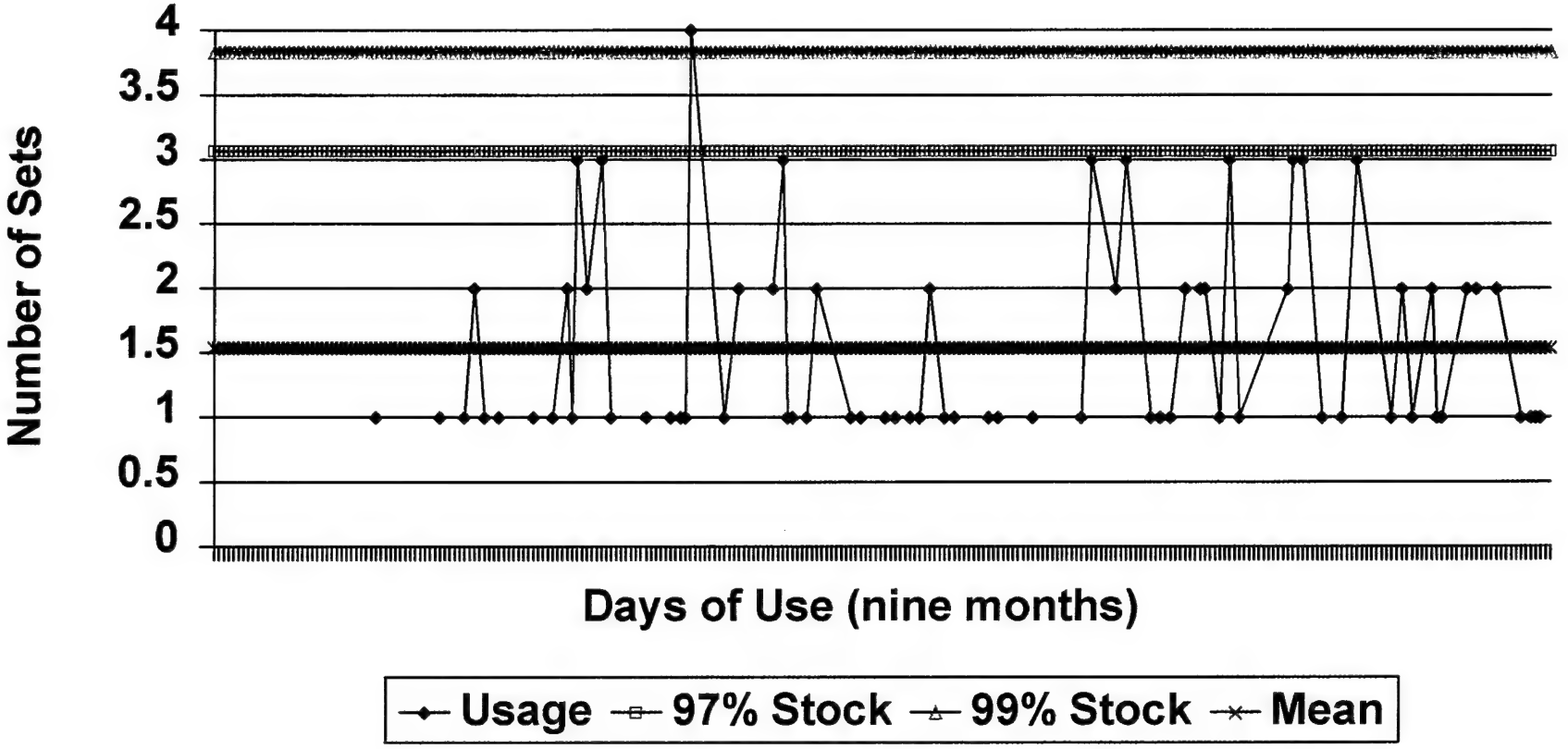
Rectal Set

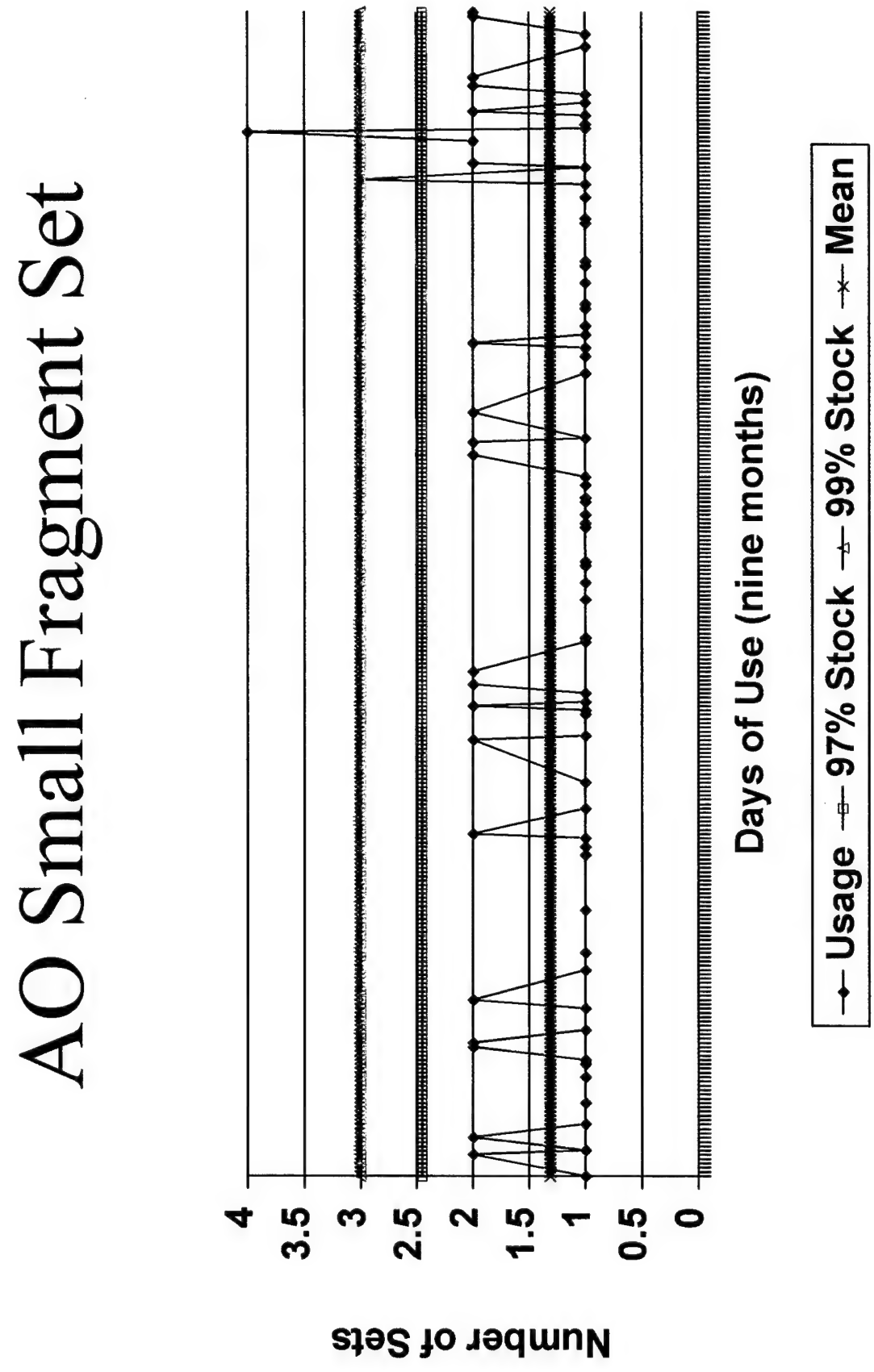

3.5
3
2.5
2
1.5
1
0.5
0
Number of Sets
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Jako Micro-Laryngeal Bx Set (New)

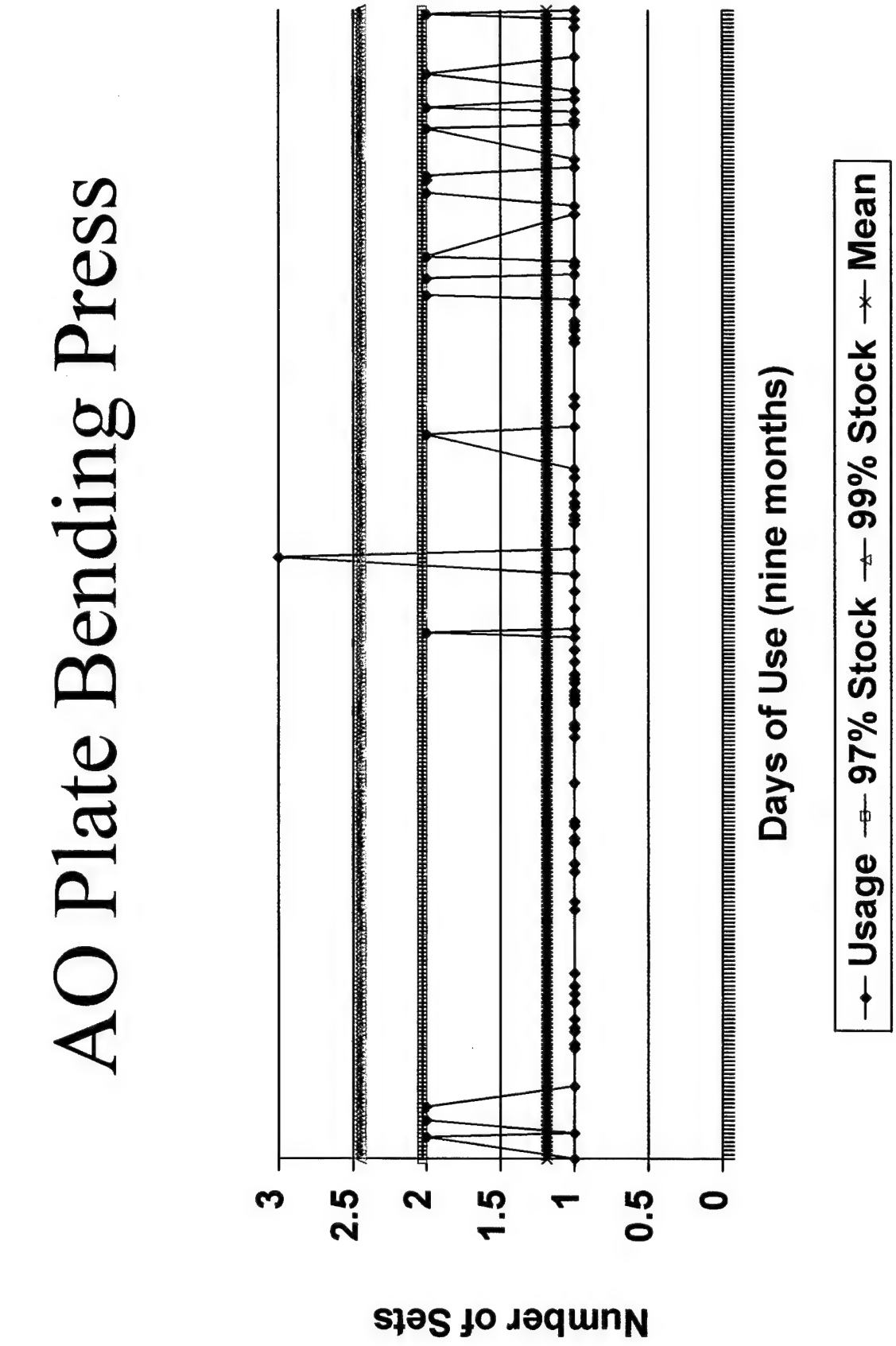


Debakey Dialators - Long

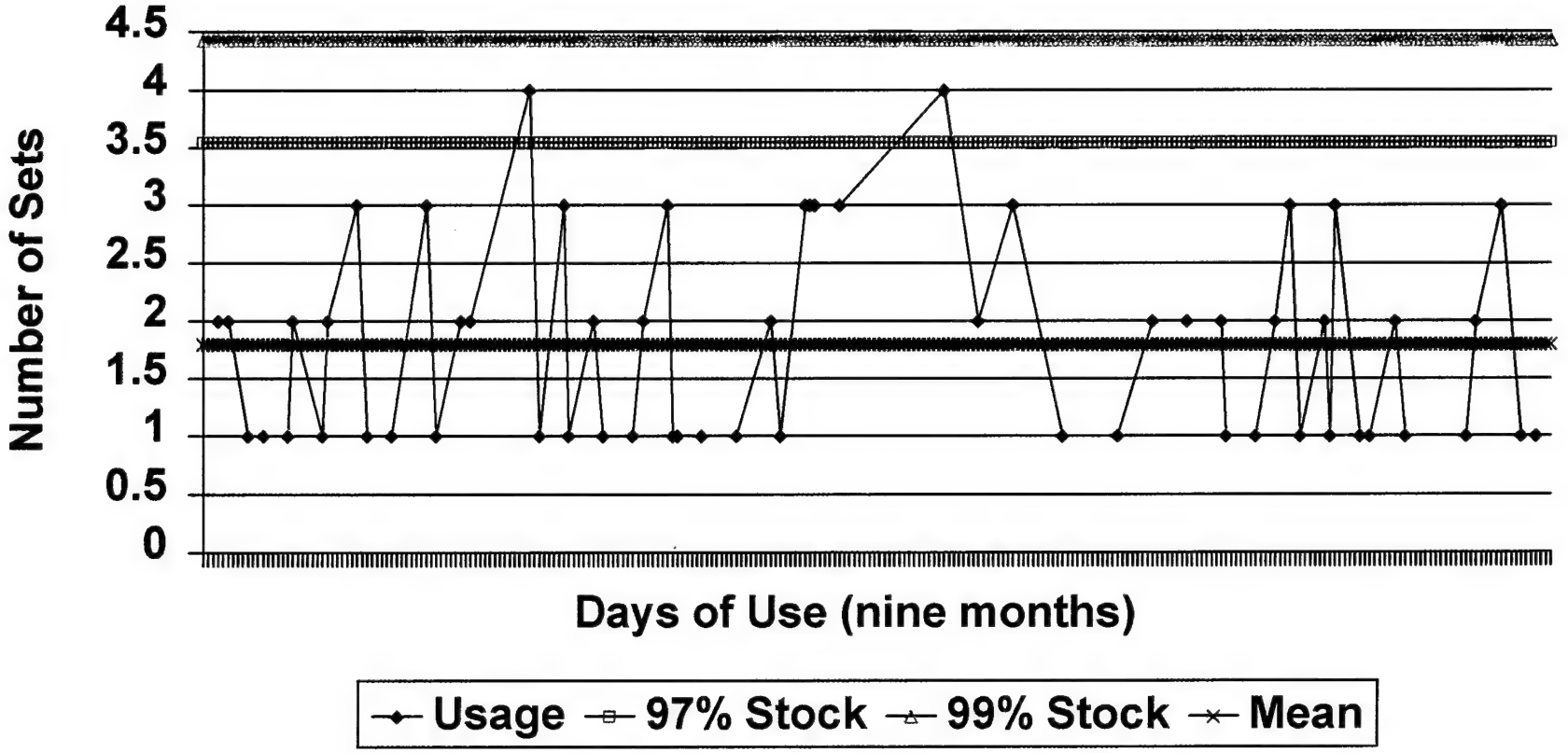



AO Small Fragment Set
Number of Sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

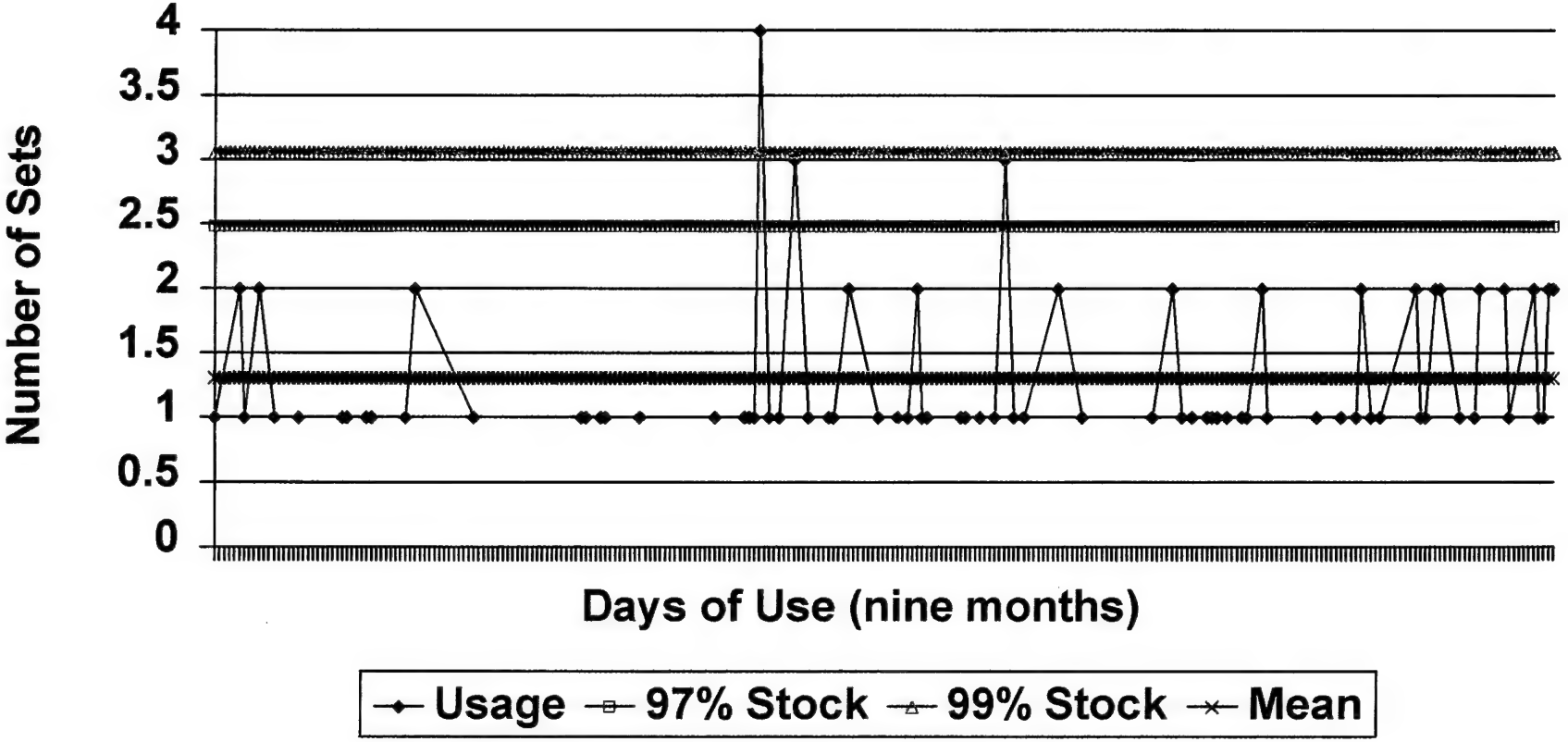
AO Plate Bending Press

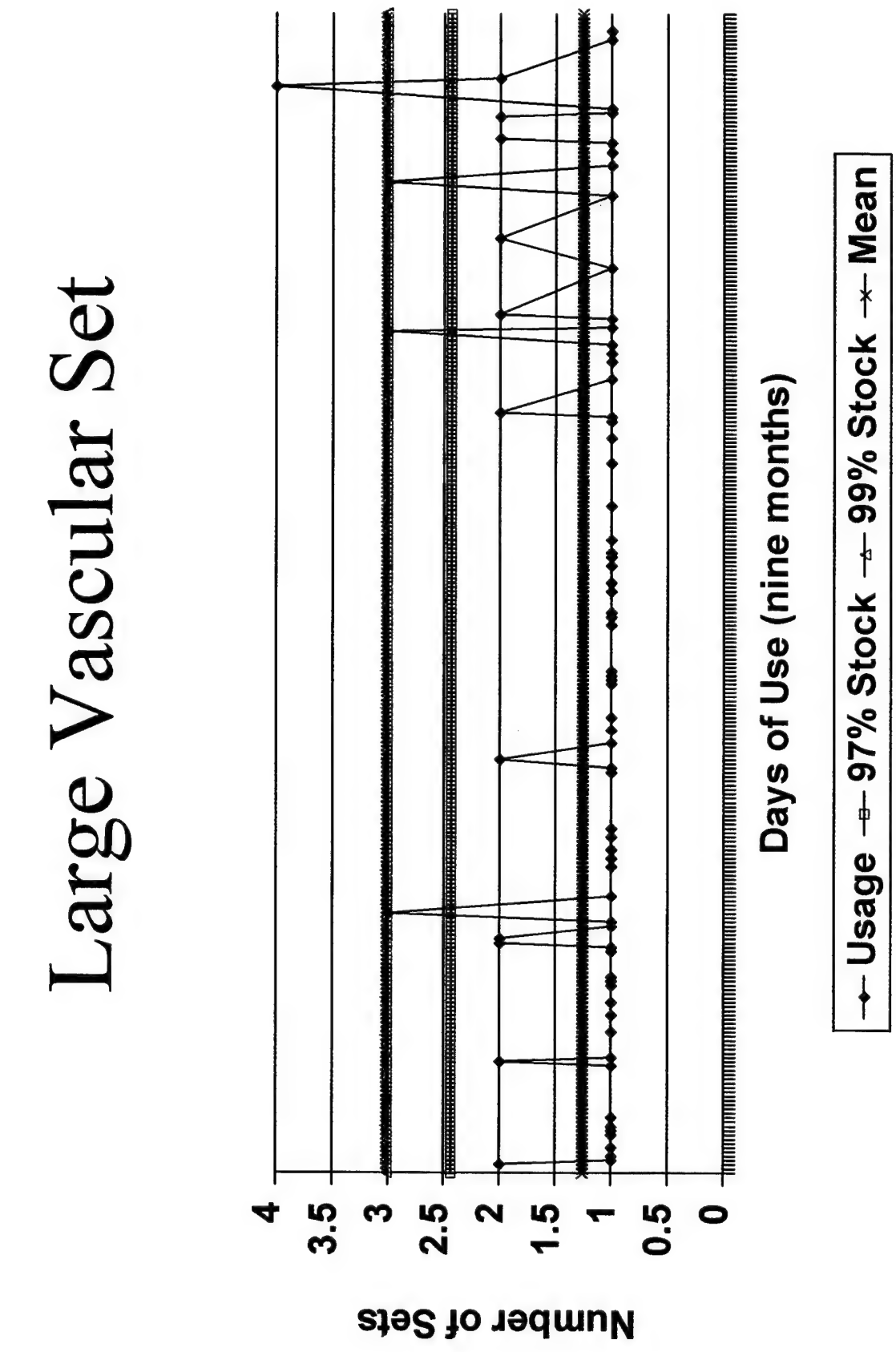


Lid/Blepharoplasty Set

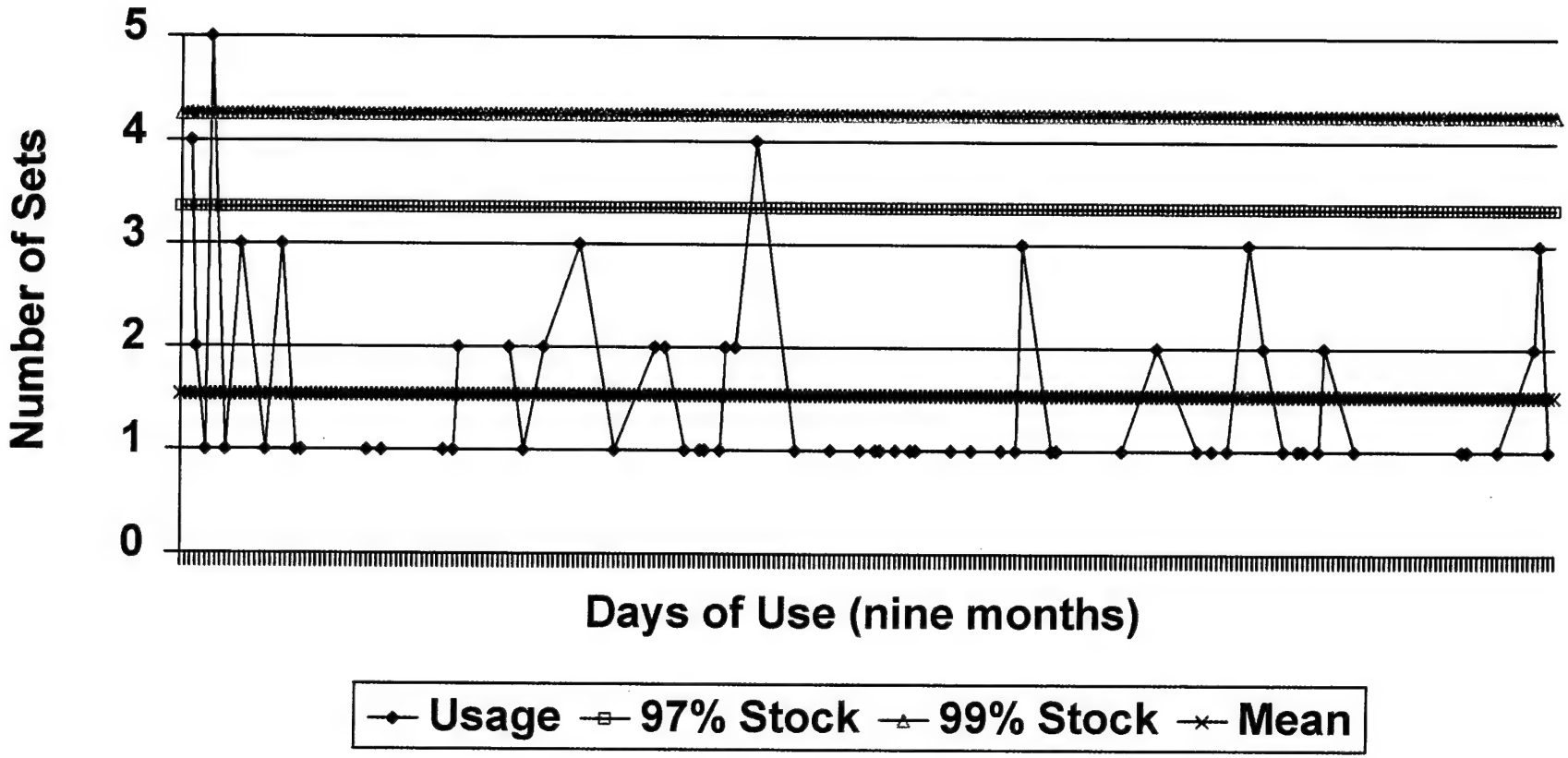


AO Bone Reduction Forceps

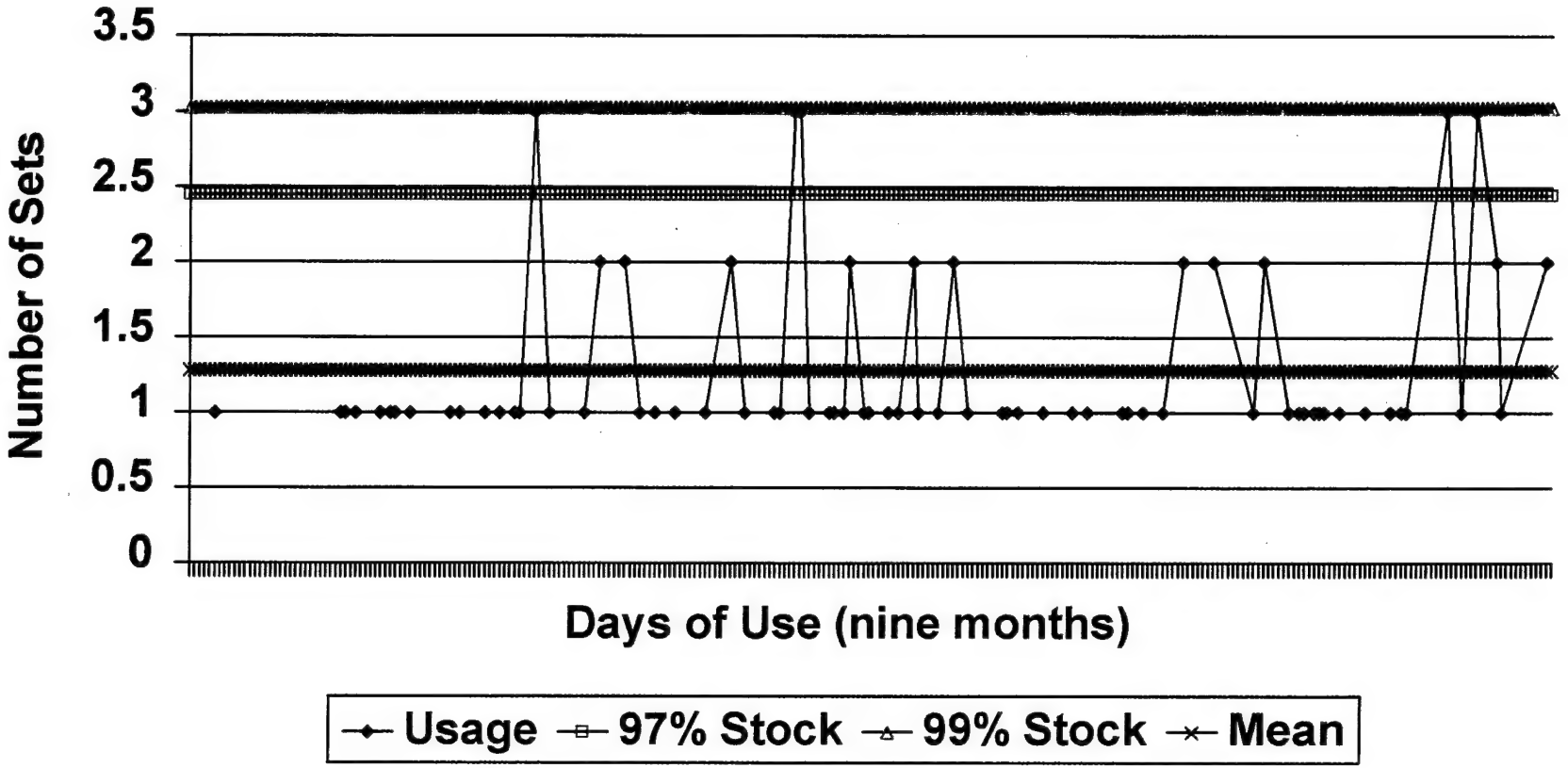


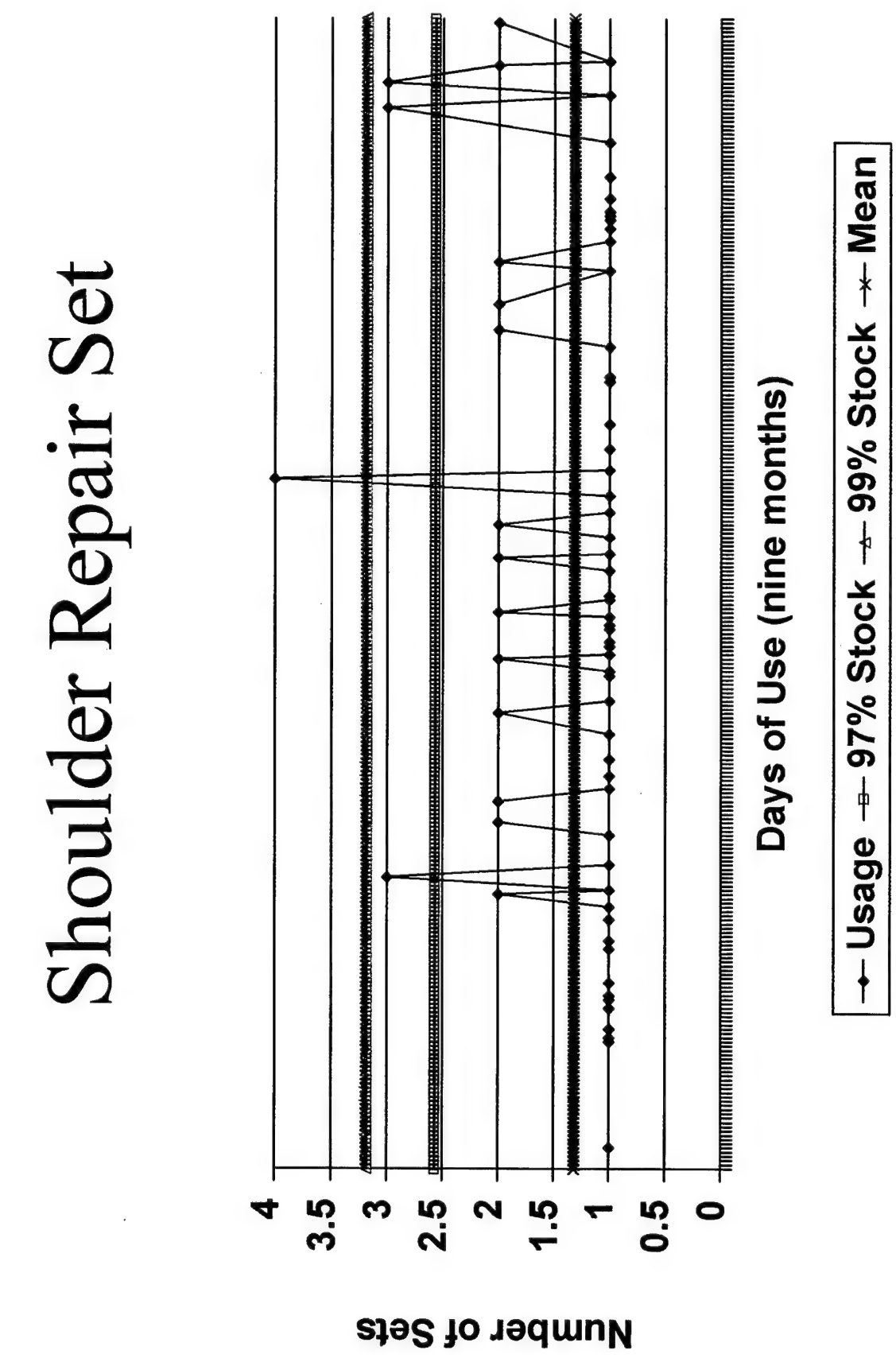

Large Vascular Set
Number of Sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

Urethropexy/Colpopexy Set

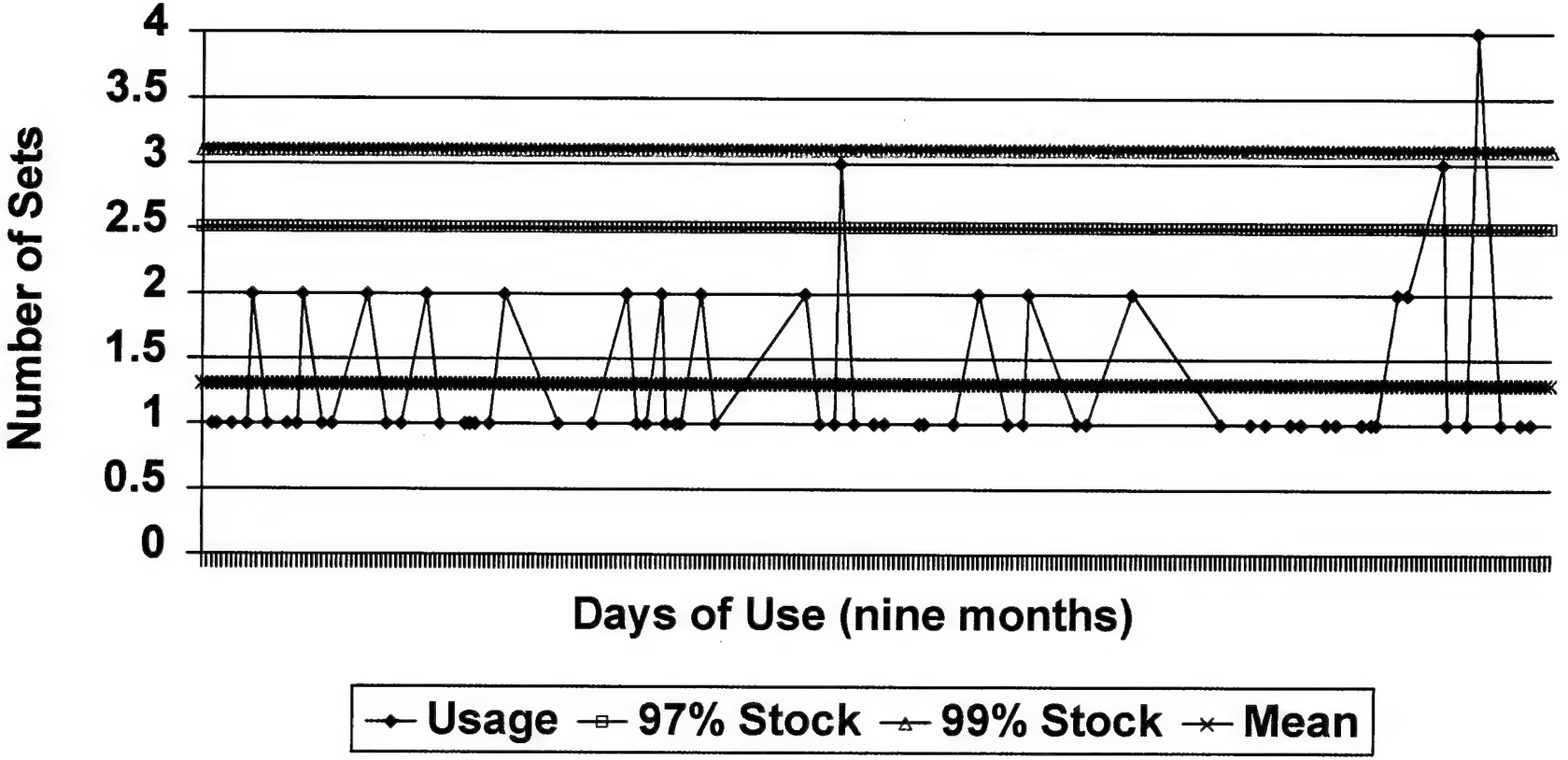


Scoville Retractor

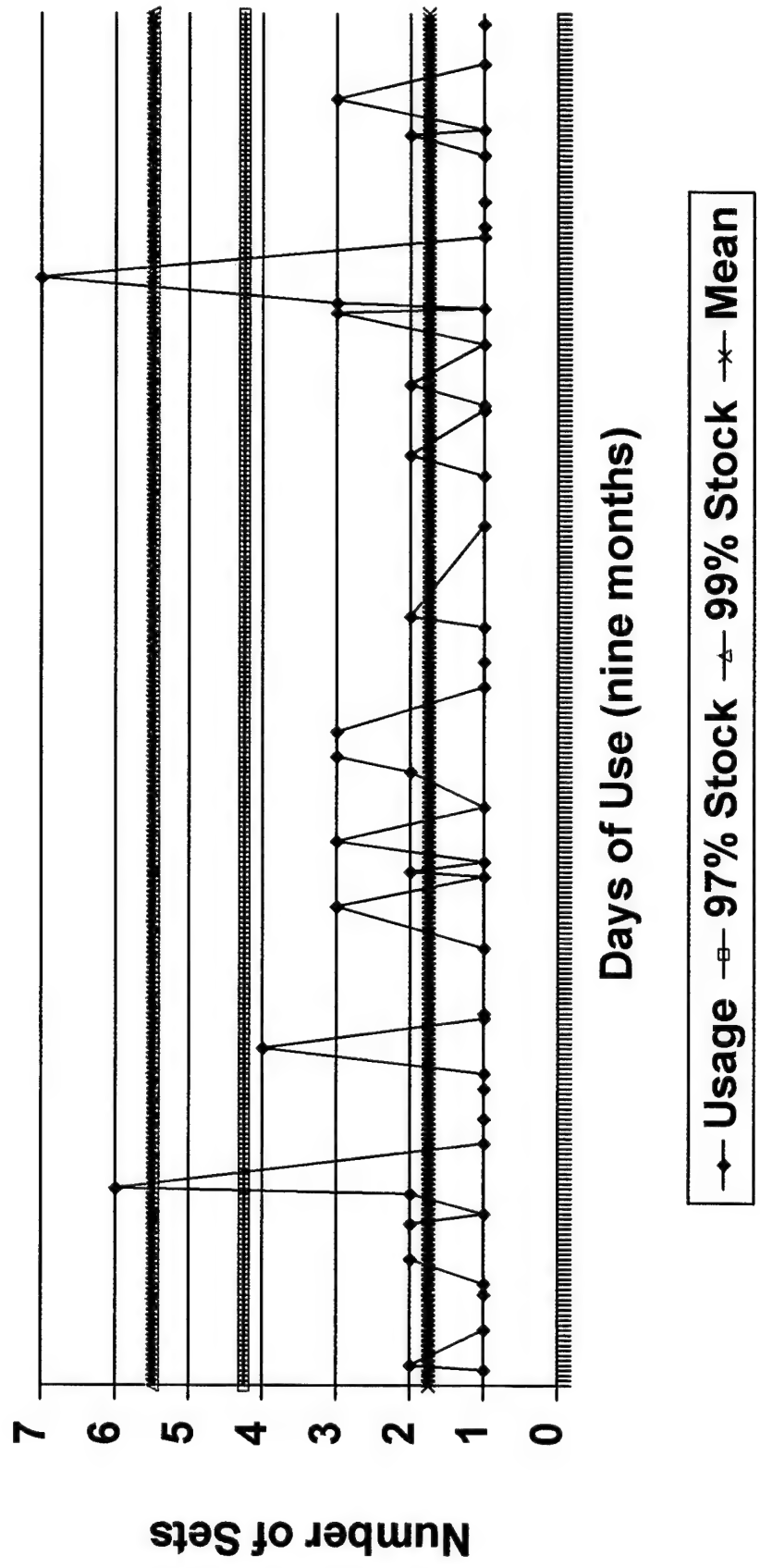



Shoulder Repair Set
Number of Sets
4
3.5
3
2.5
2
1.5
1
0.5
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

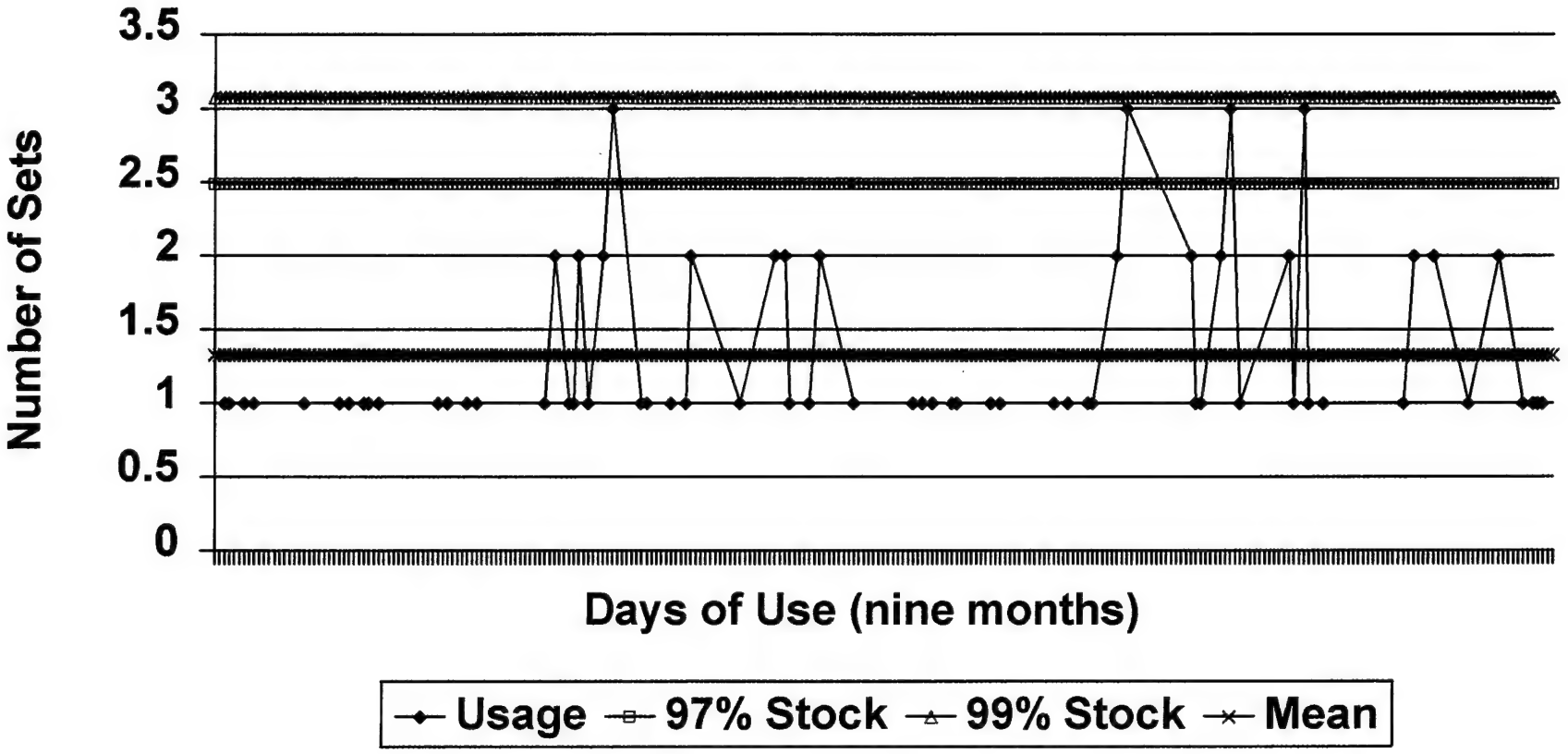
ACL Reconstruction Set



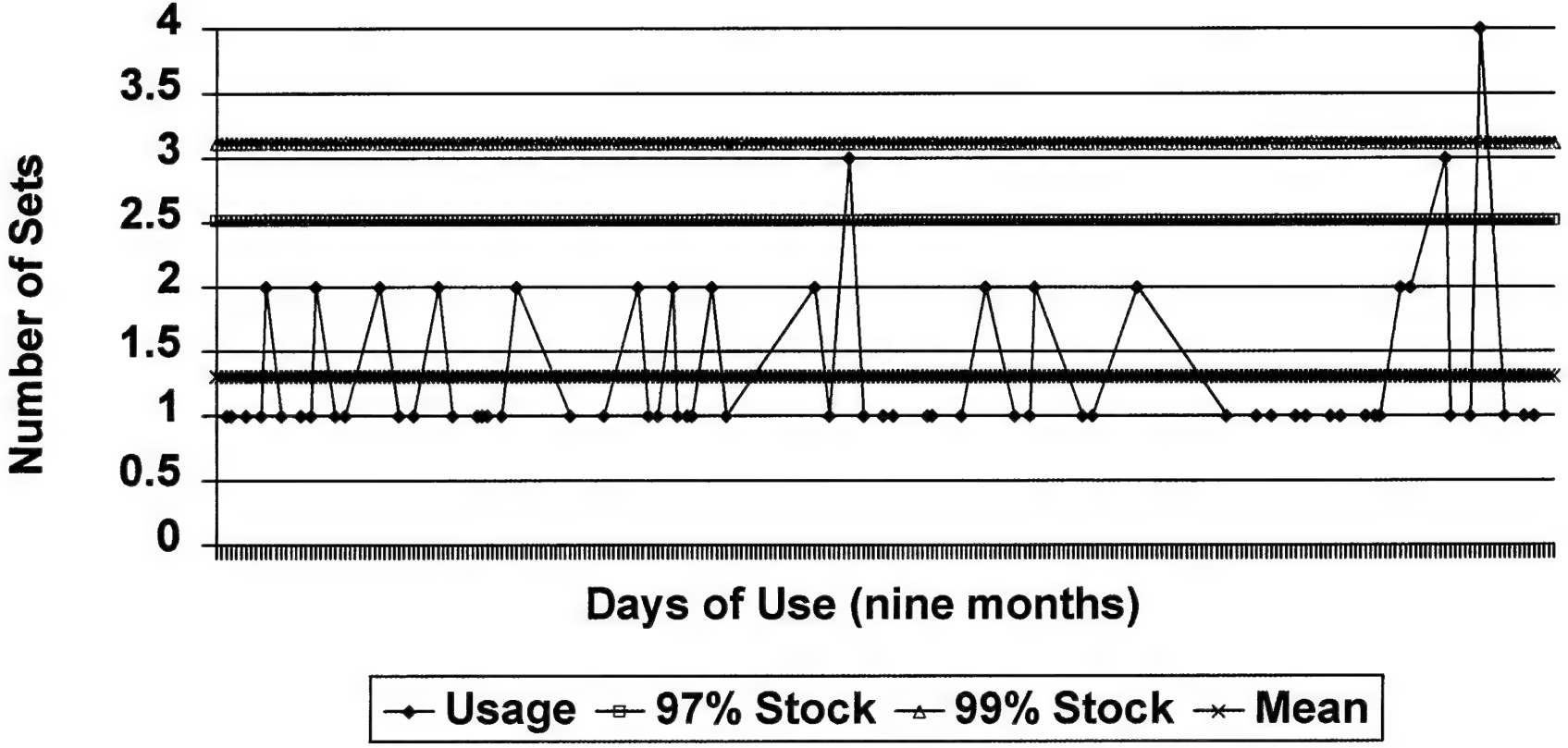
OS Minor Set


Number of Sets
7
6
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

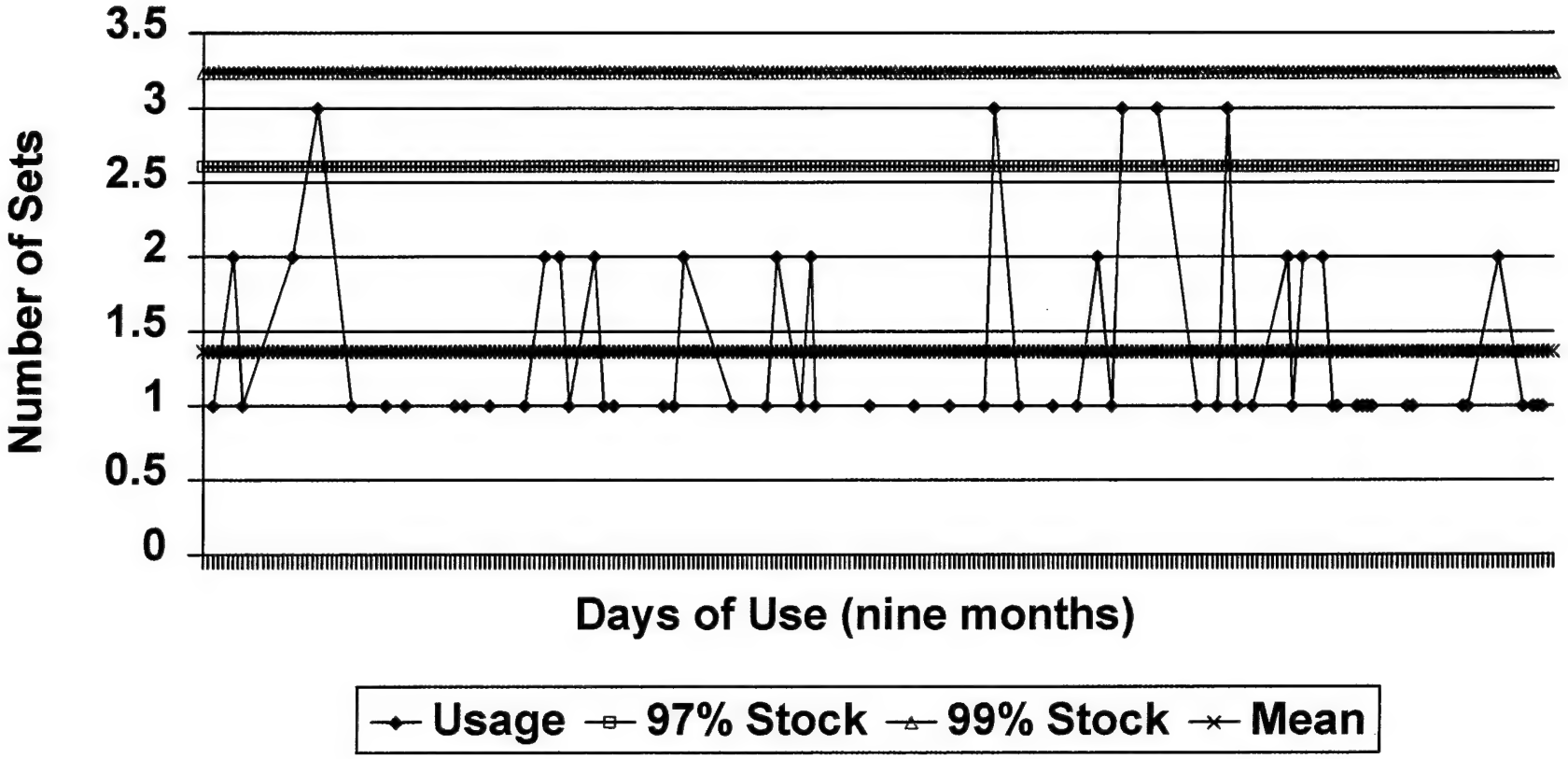
Small Vascular Set

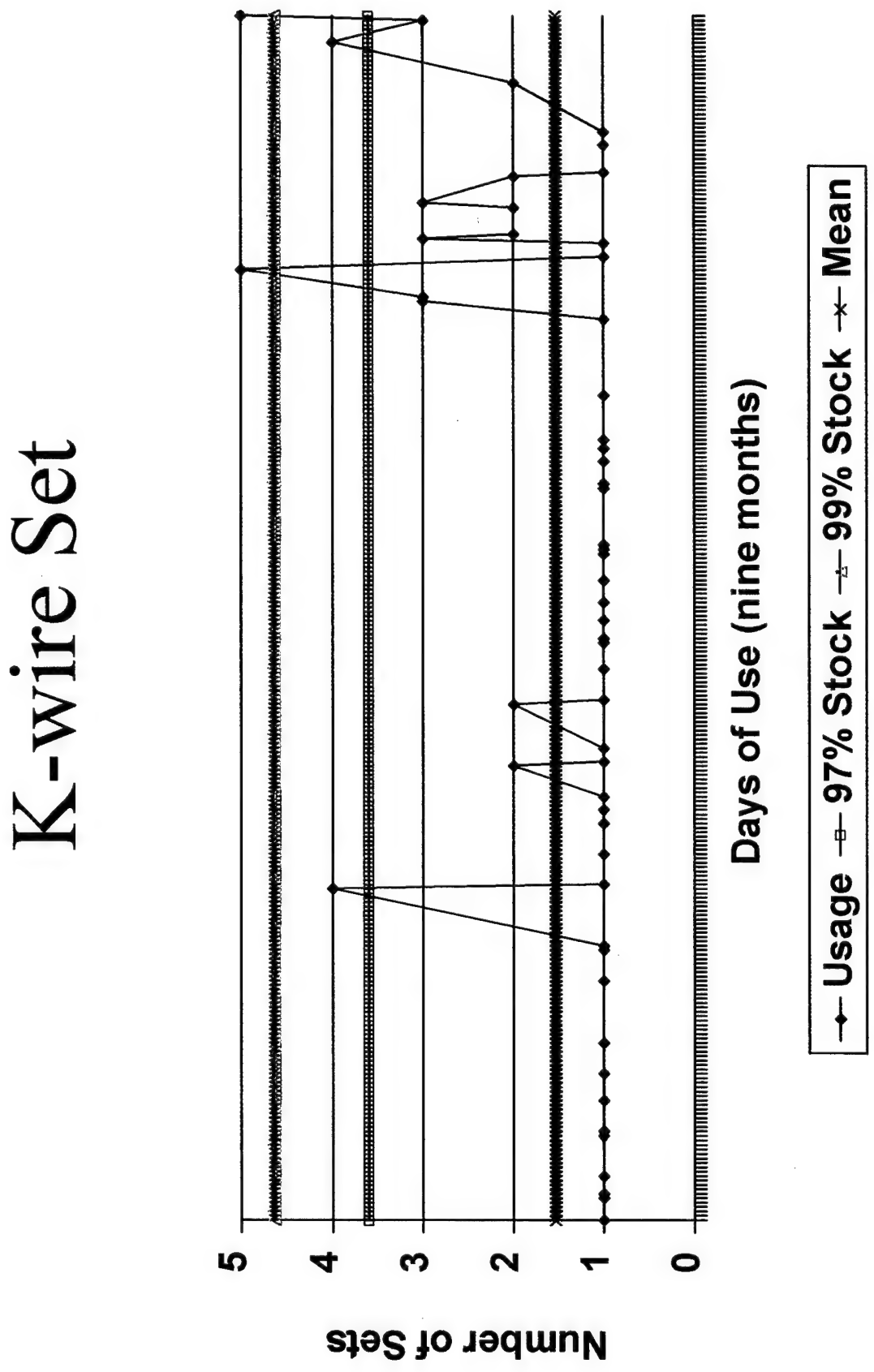


Acufex Drill System



Heifetz Clip Applier/Bulldogs




K-wire Set
Number of Sets
5
4
3
2
1
0
Days of Use (nine months)
Usage
97% Stock
99% Stock
Mean

APPENDIX F

COMPUTED STOCKAGE RATES FOR TOP 80 INSTRUMENT SETS

Nomenclature	Computed Mean	Computed Standard Deviation	97% Stock Level	99% Stock Level	Current Stock Level	97% Excess or Shortage	99% Excess or Shortage
BASIC LAPAROTOMY SET	6.15	3.41	12.98	16.39	15	2	-1
OB INSTRUMENT/DOUBLE BASIN SET	4.21	2.86	9.93	12.79	12	2	-1
MINOR SURGERY SET	3.73	2.49	8.7	11.19	10	1	-1
BASIC ORTHO SET	2.95	1.92	6.79	8.71	8	1	-1
HAND SET	3.18	2.27	7.71	9.98	6	-2	-4
LARYNGEAL MIRRORS	3.07	1.67	6.41	8.08	10	4	2
LAMBOTTE OSTEOTOMES	2.32	1.35	5.03	6.38	4	-1	-2
C-SECTION SET	2.25	2.06	6.37	8.42	3	-3	-5
BOOKWALTER W/LARGE OVAL/ROUND RINGS	2.23	1.42	5.07	6.49	3	-2	-3
MINI DRIVER	2.29	1.36	5.02	6.38	4	-1	-2
LAPAROSCOPIC BASIC TRAY	2.98	1.99	6.97	8.96	8	1	-1
LIGACLIP APPLIER LONG STRAIGHT	2.42	1.34	5.1	6.44	6	1	0
MYRINGOTOMY SET	5.78	6.35	18.47	24.82	20	2	-5
GI SPECIALS	2.03	1.34	4.71	6.04	4	-1	-2
EYE MICROSCOPE (WILD) HANDLE COVERS	3.13	1.92	6.97	8.88	6	-1	-3
T&A SET	2.75	1.37	5.5	6.87	6	1	-1
MCINTYRE CANNULA SET	3.02	1.77	6.55	8.32	5	-2	-3
LAPAROSCOPE ANY DIAG 10MM/0DEG	2.64	1.7	6.04	7.74	18	12	10
VASCULAR NEEDLE HOLDERS	2.28	1.3	4.88	6.18	4	-1	-2
CONCEPT INTRA-ARC SHAVER SYSTEM	2.32	1.23	4.78	6	4	-1	-2
HASSON INSTRUMENTS	2.74	1.73	6.2	7.93	4	-2	-4
ARTHROSCOPE WOLF 4MM/25 DEG	2.29	1.22	4.73	5.94	9	4	3
NASAL PREP SET	2.53	1.41	5.35	6.77	7	2	0
ENT SEPTO-RHINOPLASTY SET	2.54	1.41	5.36	6.77	5	0	-2
DELICATE EXTRAS	2.01	1.41	4.83	6.24	6	1	0
D&C SET	2.21	1.6	5.42	7.02	6	1	-1
CATARACT SET	2.67	1.74	6.14	7.88	4	-2	-4
GYN SPECIALS SET	2.2	1.28	4.77	6.05	4	-1	-2
STEINMAN PIN SET SMOOTH	1.81	1.1	4.02	5.12	3	-1	-2
MICRO AIRE DRILL	2.1	1.36	4.83	6.19	4	-1	-2
BASIC PLASTIC SET	2.23	1.22	4.67	5.88	5	0	-1
LIGACLIP APPLIER LONG ANGLED	2	1.09	4.19	5.28	6	2	1
BUNION SET	2.77	1.47	5.71	7.17	6	0	-1
PHACO INSTRUMENT	2.54	1.63	5.79	7.42	2	-4	-5
GENERAL SURGERY ENDOSCOPY SET	1.79	0.88	3.54	4.42	4	0	0
LAPAROSCOPE OLYMPUS DIAG 10MM/0DEG	1.75	0.89	3.52	4.41	1	-3	-3
ARTHROSCOPY INSTRUMENT SET	1.87	1.01	3.9	4.91	6	2	1
GYN ENDOSCOPY INSTRUMENTS	1.91	1.38	4.67	6.05	2	-3	-4
HALL STERNAL SAW	1.63	0.76	3.15	3.91	3	0	-1
BABY LAPAROTOMY SET	1.72	0.94	3.6	4.53	3	-1	-2
OPEN HEART CHEST TRAY	1.57	0.73	3.03	3.75	3	0	-1
MAXI DRIVER	1.57	0.93	3.43	4.36	4	1	0

Nomenclature	Computed Mean	Computed Standard Deviation	97% Stock Level	99% Stock Level	Current Stock Level	97% Excess or Shortage	99% Excess or Shortage
BALFOUR RETRACTOR	1.84	0.96	3.77	4.73	5	1	0
OPEN HEART LEG TRAY	1.53	0.71	2.95	3.66	3	0	-1
COBB ELEVATOR SET	1.62	0.89	3.4	4.29	3	0	-1
VASCULAR SCISSOR SET	1.72	0.91	3.53	4.44	2	-2	-2
FOGARTY CLAMP SET	1.7	0.9	3.5	4.39	2	-1	-2
SIEMANS INTERNAL DEFIB PADDLES	1.56	0.72	3	3.72	3	0	-1
CORONARY SPECIALS	1.48	0.68	2.83	3.51	3	0	-1
RHOTON DISSECTOR TRAY	1.66	0.96	3.58	4.54	2	-2	-3
OPEN HEART FAVOLORO RETRACTOR	1.45	0.66	2.77	3.43	3	0	0
ENT BASIC SET	1.76	1.06	3.88	4.94	5	1	0
RICHARDS CURRETTE SET	1.43	0.67	2.76	3.43	3	0	0
TVH SET	1.69	1.06	3.8	4.86	4	0	-1
NEURO BACK SET	1.64	0.78	3.2	3.98	2	-1	-2
BTL ENDOSCOPY SET	2.12	1.27	4.65	5.92	3	-2	-3
NEURO RONGEUR PAN	1.48	0.71	2.9	3.61	4	1	0
THORACOTOMY RETRACTORS	1.49	0.71	2.92	3.63	2	-1	-2
ENT SOFT TISSUE SET	1.56	0.77	3.1	3.86	6	3	2
THORACOTOMY SPECIALS	1.54	0.74	3.01	3.74	2	-1	-2
MIDDLE EAR SPECIALS	1.85	0.98	3.81	4.79	5	1	0
VASCULAR GRAFT SET	1.48	0.75	2.98	3.73	1	-2	-3
MIDDLR EAR EXTRAS	1.83	0.9	3.63	4.53	5	1	0
RECTAL SET	1.38	0.61	2.61	3.22	3	0	0
JAKO MICRO-LARYNGEAL BX SET (NEW)	1.61	1.03	3.68	4.71	4	0	-1
DEBAKEY DIALATORS - LONG	1.54	0.77	3.07	3.83	1	-2	-3
AO SMALL FRAGMENT SET	1.32	0.56	2.45	3.01	2	0	-1
AO PLATE BENDING PRESS	1.19	0.42	2.03	2.45	1	-1	-1
LID/BLEPHAROPLASTY SET	1.8	0.88	3.55	4.43	2	-2	-2
AO BONE REDUCTION FORCEPS	1.31	0.58	2.48	3.06	2	0	-1
LARGE VASCULAR SET	1.26	0.59	2.43	3.02	2	0	-1
URETHROPEXY/COLPOPEXY SET	1.54	0.91	3.35	4.26	2	-1	-2
SCOVILLE RETRACTOR	1.28	0.58	2.45	3.03	3	1	0
SHOULDER REPAIR SET	1.32	0.63	2.57	3.19	1	-2	-2
ACL RECONSTRUCTION SET	1.31	0.6	2.51	3.11	1	-2	-2
OS MINOR SET	1.75	1.25	4.25	5.5	4	0	-1
SMALL VASCULAR SET	1.33	0.58	2.49	3.08	2	0	-1
ACUFEX DRILL SYSTEM	1.31	0.6	2.52	3.12	2	-1	-1
HEIFETZ CLIP APPLIER/BULLDOGS	1.37	0.62	2.61	3.24	2	-1	-1
K-WIRE SET	1.54	1.03	3.6	4.64	3	-1	-2

WORKS CITED

Andersen, Karen, and Judy Bourne, "An Innovative Approach to Endoscopic Instrumentation", Minimally Invasive Surgical Nursing, 8, no. 3, (1994 Fall): 103-5.

Anderson, Patti, "Dive into waste reduction: Start by buying smart", Materials Management, 2, no. 9, (September 1993): 18-21.

Annis, Rick, "Proper Inventory Management can improve Hospital's cash flow", Health Progress, 69, no. 7, (September 1988): 80-1.

Armstrong, Scott, Hospital Administrator of Group Health Cooperative of Puget Sound, interview by author, 19 April 1995, Seattle, Washington.

Barlow, Rick Dana, "Standard sets key hurdle", Hospital Purchasing News, (June 15, 1994)(reprint).

Becker, G. Edward, "Surgical Instruments: the unmanaged asset", Journal of healthcare material management, 8, no. 3, (April 1990): 40, 42, 44-6.

Breazile, R. A., letter to Major Williams of Madigan Army Medical Center, August 5, 1994. Madigan Army Medical Center, Tacoma, Washington.

Comerford, Tedd Alan, "CS work simplification: Computerizing with a restrained budget", Journal of healthcare materiel management, 10, no. 5, (June 1992): 41-5.

Congdon, John R., "Cutting a purchase order: Little things can cost a lot", Materials Management, 1, no. 6, (August 1992): 18-24.

Drucker, Peter F., "The Information Executives Truly Need", Harvard Business Review, (January-February 1995): 54-62.

Hall, John, "Small victories pave the road to OR cost savings", Hospital Purchasing News, 18, no. 5, (May 15, 1994): 1, 31-2.

Hard, Rob, "Automation options for small hospitals", Materials Management, 1, no. 5, (July 1992): 30-2.

Hard, Rob, "Automation helps CS track instrument use", Materials Management, 1, no. 1, (March 1992): 40-1.

Hard, Rob, "OR System investments offer hospitals financial gains", Hospitals, 64, no. 12, (June 20, 1990): 60-2.

Hylton, Betty, "Controlling O.R. Inventory with Notebook Computers: A Case Study", Nursing Management, 18, no. 8, (August 1987): 80-1.

Klee, William, "ABC^3: analyzing on-hand investment", Materials Management, 1, no. 4, (June 1992): 24-30.

"Management Study of Central Materiel Supply (CMS) Budget Overruns", 20 October 1993, performed by Management Analysis Branch, Resource Management Division, Madigan Army Medical Center, Tacoma, Washington.

Matwyshyn, Ihor, and Mark Weinberg, "Reducing Materials management costs with microcomputers", Healthcare Financial Management, 38, no. 8, (August 1984): 58-62.

McLean, Valerie J., "Computerized Preference Lists: Using Computers to Integrate and Improve Patient Care", AORN Journal, 52, no. 3, (September 1990): 509-522.

Navarre, Dick, "Micro chip leads to maxi savings", Computers in Healthcare, 7, no. 9, (September 1986): 34-6.

Newman, Mary Rose, and Matthew Bender, "Managing O.R. inventory may be easier than you think", Materials Management, 1, no. 9, (November 1992): 11-2.

Robinson, Judy, and Susie Coates, "Controlling Inventory: a cooperative system between the OR and Materiels Management", AORN Journal, 53, no. 5, (May 1991): 1209-1213.

Sabatino, Frank G., "Productivity: finding methods of measurement", Materials Management, 1, no. 8, (October 1992): 16-20.

Souhrada, Laura, "Costly instrument repairs got you down? Chart your own solution", Materials Management, 3, no. 6, (June 1994): 60-4.

Starr, Mary, "Here's a new twist: Cut OR inventory before taking count", Materials Management, 2, no. 8, (August 1993): 28-30.

Sussman, Lyle, and Yash Gupta, "Different Perspectives of Inventory Management Among Physicians and Hospital Administrators", The American Journal of Surgery, 164, no. 1, (July 1992): 1-2

"The tool managers will truly need is information", OR Manager", 11, no. 3, (April 1995): 21.

Walera, Ed, "JIT principles help Alta Bates cut OR costs", Materials Management, 2, no. 3, (March 1993): 25-8.

Weber, Joanne M., and Linda L. Sisson, "Computerized OR Inventory", AORN Journal, 40, no. 6, (December 1984): 867-871.